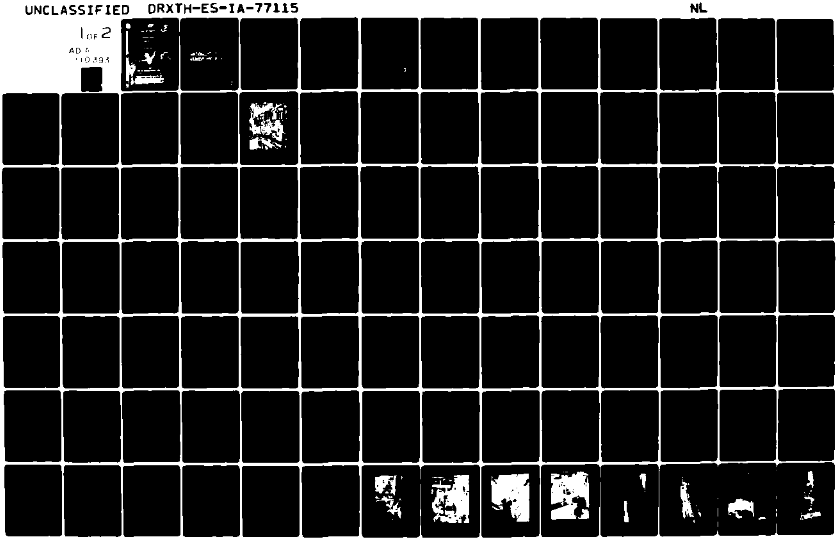
AD-A110 393 ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY ABERDEEN P--ETC F/G 13/2
INSTALLATION ASSESSMENT OF FRANKFORD ARSENAL.(U)
OCT 77

UNCLASSIFIED DRXTH-ES-IA-77115 NL

1 OF 2

AD A
110393



MICROCOPY RESOLUTION TEST CHART

AD A110393

SECURITY CLASSIFICATION OF THIS PAGE (*When Data Entered*)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER DRXTH-ES-IA-77115 ✓	2. GOVT ACCESSION NO. AD-A110393	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (*and Subtitle*) Installation Assessment of Frankford Arsenal		5. TYPE OF REPORT & PERIOD COVERED Final
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Chemical Systems Laboratory Aberdeen Proving Ground, MD 21010		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Toxic and Hazardous Materials Agency ATTN: DRXTH-ES APG, MD 21010		12. REPORT DATE Oct 77
		13. NUMBER OF PAGES 138
14. MONITORING AGENCY NAME & ADDRESS(*if different from Controlling Office*)		15. SECURITY CLASS. (*of this report*) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (*of this Report*)

Distribution unlimited. Cleared for public release.

17. DISTRIBUTION STATEMENT (*of the abstract entered in Block 20, if different from Report*)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (*Continue on reverse side if necessary and identify by block number*)

Installation Restoration
US Army Toxic and Hazardous Materials Agency
Frankford Arsenal

20. ABSTRACT (*Continue on reverse side if necessary and identify by block number*)

An on-site installation assessment was conducted on 27 June - 7 July 1977 at Frankford Arsenal, Philadelphia, PA, to determine the presence of any toxic or hazardous materials and to assess the potential for offpost migration. It was recommended that the findings of this assessment be incorporated into the planned decontamination effort at Frankford Arsenal.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (*When Data Entered*)

INSTALLATION ASSESSMENT

OF

FRANKFORD ARSENAL

RECORDS EVALUATION REPORT NO. 115

PREPARED BY: DAMON D. WINGFIELD
Colonel, CmlC
Asst Proj Mgr for
Instl Restoration

REVIEWED: DOUGLAS J. WOOD
Lieutenant Colonel, AR
Commander, Frankford Arsenal
Caretaker Activity

APPROVED: FRANK A. JONES, JR.
Colonel, CmlC
Project Manager for
Cml Demil and
Instl Restoration

DTIC
ELECTE
FEB 3 1982
D
A

This document has been approved
for public release and sale; its
distribution is unlimited.

ACKNOWLEDGEMENTS

The Records Research Team acknowledges the administrative and technical assistance provided by the various agencies throughout the Team visit. In particular, the cooperation of the present and former employees of Frankford Arsenal is especially appreciated.

DTIC COPY INSPECTED 1

Availability Codes
Dist | Avail and/or Special
A

RE: Distribution Statement
Approved for Public Release per
Mr. George Baker, ATHMA/DRXTH-ES

EXECUTIVE SUMMARY

I. GENERAL

A. A record search was conducted on Frankford Arsenal (FFA), Philadelphia, Pennsylvania, to uncover indications of possible contamination at the installation by chemical, biological, and radiological materials resulting from past manufacturing, testing, storage, and disposal operations; and to assess the possibility of contaminant migration beyond the installation boundaries.

B. The onsite phase of the search was performed from 27 June through 7 July 1977; however, historical data were collected from other agency sources through 21 September 1977.

C. The procedure followed by the Records Research Team included:

1. Acquiring all pertinent documents on FFA from other government agencies including:

   a. Department of Defense Explosive Safety Board (DDESB).

   b. US Army Environmental Hygiene Agency (USAEHA).

   c. US Geological Survey (USGS).

   d. Defense Documentation Center (DDC).

   e. US Army Engineers Waterways Experiment Station (WES).

   f. National Technical Information Serivce (NTIS).

   g. Rock Island Arsenal Historical Office.

   h. National Archives.

2. Obtaining copies of all pertinent onsite installation regulations, standing operating procedures, and other available documentation.

3. Interrogating present and former key employees and Chemical Systems Laboratory personnel assisting in the FFA closure procedures.

4. Analyzing the above information.

D. This report reflects the status of Frankford Arsenal as of 4 August 1977.

II. FINDINGS

A. Propellant and Pyrotechnic Wastes from Production Activities

The production areas of the Arsenal are contaminated or potentially contaminated with explosive, pyrotechnic, or propellant wastes resulting from the manufacture and loading of small arms ammunition, tracer ammunition, propellant and cartridge actuated devices, and lead styphnate.

B. Disposal Operations

There are no areas currently used as landfills for military or sanitary wastes. All such materials were removed by a contractor or by shipment to a military installation capable of disposing of explosive wastes (Letterkenny Army Depot). Evidence does exist of prior disposal, by burial, circa the Civil War period.

A small burning area, designated as building 439, was used for incinerating limited quantities of material. The ash was containerized and disposed of as contractor serviced scrap.

Quantities of ammunition are reported to be present in the adjacent Frankford Creek and Delaware River as a result of target overshoot and expedient disposal activities in the past.

C. Range Operations

Buildings 521 and 150 contain a series of indoor target ranges used for ammunition testing. Three outdoor target ranges once existed in the east-central area of the Arsenal. Two ranges have been superseded by building construction, and the target butt of the third has been removed.

Building 316 was the site of the cartridge actuated devices ballistic testing.

Of the above ranges, the activities at building 521 remain operational with its functions scheduled for transfer to Fort Dix, New Jersey.

Unexploded ordnance (UXO) is suspected to be present at several sites. Civil War material was found at the present site of the Walbash Gate, and World War I munitions were reported to be found during building construction in the vicinity of two former outdoor ranges. There are no records indicating disposal operations to remove the UXO from these sites.

D. Chemical, Biological, and Radiological Materials

Large quantities of commercial chemicals related to production and plating operations exist scattered throughout the installation. The most

notable of these sites is the plating shop, building 45, where the cyanide and acid baths remain.

Mercury contamination was also found; approximately one ton of the containerized liquid metal was found onsite. This find is attributed to post clean-up exercise, where large quantities of laboratory reagents were accumulated and consolidated in a holding area of the Pitman-Dunn Laboratory, building 64.

Large quantities of radiological materials remain in storage at the Arsenal, the major portion being 5,393 kilograms of depleted uranium stored in buildings 227B, 149, and 150.

E. <u>Water Quality</u>

Frankford Arsenal obtains its water from the Philadelphia water system and returns the waste water to the city's sanitary sewer system. Data available on the analysis of this waste stream gives no indication of contamination. It should be noted that the sanitary waste analysis does not include tests for explosive or propellant components (e.g., PETN).

F. <u>Contaminant Migration</u>

The area of concern is the Fitler or "400" Area, the former site of the lead styphnate production. The sewer lines are suspected of being contaminated. These lines terminate at the catch basin for the 400 Area on the bank of the Delaware River. The basin is in a state of disrepair.

It is believed that any subsurface contamination due to historical activities may be a potential problem.

III. CONCLUSIONS

Areas of potential explosive/pyrotechnic, radiological, chemical, and unexploded ordnance contamination were identified and, in addition, other areas of potential contamination were documented.

IV. RECOMMENDATIONS

It is recommended that the findings of the Records Research Team be reviewed by personnel responsible for the decontamination program at FFA and, where applicable, be incorporated into the program.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDIXES

I. GENERAL

A. Purpose of the Assessment

1. To confirm previously known areas of contamination and to determine if other undocumented contaminated areas exist at Frankford Arsenal (FFA) from a search of available records. This information, as applicable, will be incorporated into the ongoing survey.

2. To identify any immediate on-post safety hazards associated with CBR contamination and unexploded ordnance (UXO).

B. Authority

Department of the Army (DA) charter for the Project Manager for Chemical Demilitarization and Installation Restoration (PMCDIR) dated 27 April 1977.

C. Introduction

1. In pursuance of the termination of the Frankford Arsenal activities and the transfer of its mission, HQ US Army Armament Materiel Readiness Command (ARRCOM) requested PMCDIR to undertake a search of FFA records.

2. Personnel from FFA were briefed on the program prior to the start of the on-site records search. The purpose of the briefing was to outline the assessment scope and to provide guidelines to FFA personnel for the records search. The former installation commander, LTC F. W. Hackley, established the Team's point of contact.

3. Before the actual on-site review of records began, various government agencies were contacted for documents pertinent to the records search effort. Agencies contacted included:

a. Department of Defense Explosive Safety Board (DDESB).

b. US Army Environmental Hygiene Agency (AEHA).

c. US Geological Survey (USGS).

d. Defense Documentation Center (DDC).

e. US Army Engineer Waterways Experiment Station (WES).

f. National Technical Information Service (NTIS).

4. Subsequent to the records search the following agencies were contacted for confirmation of historical records:

a. Rock Island Historical Office.

b. National Archives.

5. The collection of documents occurred during the period 25 July through 4 August 1977. The following Team members provided input to this report:

a. Mr. William Collins (Team Leader).

b. Mr. Norman Leibel (Ordnance Specialist).

c. LT Charles Brenner (Chemical Engineer).

d. Mr. Donald Gross (Chemical Engineer/Chemical Agent Specialist).

e. Mr. James Scott (PMCDIR Representative/Chemist).

6. In addition to the review of records, interviews were conducted with approximately 31 persons, including present and former employees. (See Appendix A.) A ground tour of the installation was also made. Photographs taken during the tour are included in Appendix B. Team members also interviewed Picatinny Arsenal employees who were former FFA employees.

7. The findings, conclusion, and recommendations are based on the records made available to the Team, and the corroborated testimony of past and present employees.

D. Summary Description of Installation

1. Location and Size

Frankford Arsenal is located in the northeast section of Philadelphia, Pennsylvania. It is bound on the south by Frankford Creek, on the southeast by the Delaware River, on the north, northwest by Tacony Street, on the west by Bridge Street, and on the northeast by the Lombard Trucking Company, and Dietz & Watson, Inc.

The Arsenal complex consists of 120 permanent, 56 semi-permanent, and 36 temporary buildings. The roadnet consists of eight miles of street and roadways.

2. Area Description

The Arsenal occupies 110 acres; in addition, there are 260 acres at Fort Dix, New Jersey that are available for experimental projects and test firing.

The main area is encompassed on three sides by the city of Philadelphia, Pennsylvania, and on the other side by the Delaware River. The general area consists of a conglomeration of industry and working class residential.

Transportation facilities available are the Penn-Central Railroad, pier facilities on the Delaware River, and the trucking industry. Interstate 95 in the vicinity is parallel to the north, northwest boundary. See Figures I-1 and I-2.

3. Organization and Mission

The manpower distribution as of 28 February 1975, just prior to the issuance of the August 1975 Closure Implementation Plan, was as follows for the Arsenal and the tenant activities:

	Military			
	Officer	Enlisted	Civilian	Total
Frankford Arsenal	12	14	3427	3453
AMC Inventory Resident Office	2		12	14
USA Health Clinic, FFA			13	13
Philadelphia Naval Shipyard Disposal Division			2	2
USA Communications Command			30	30
AMC Interns			8	8

Based on the closure action, a long-term mission does not exist. See Figure I-3 for the current organization chart.

As an active Class II AMC installation, the Arsenal had the responsibility for researching, developing, designing, engineering, procuring, supplying, and/or servicing military material in the performance of national support and special missions on specified material, equipment, and systems. Additional responsibilities are as follows:

a. Operated as a commodity center for small caliber munitions, cartridge activated and propellant actuated devices; related test and handling equipment; and multi-purpose testing equipment.

b. Research was conducted in the fields of optics, metallurgy, material degradation, tracers, and laser countermeasures.

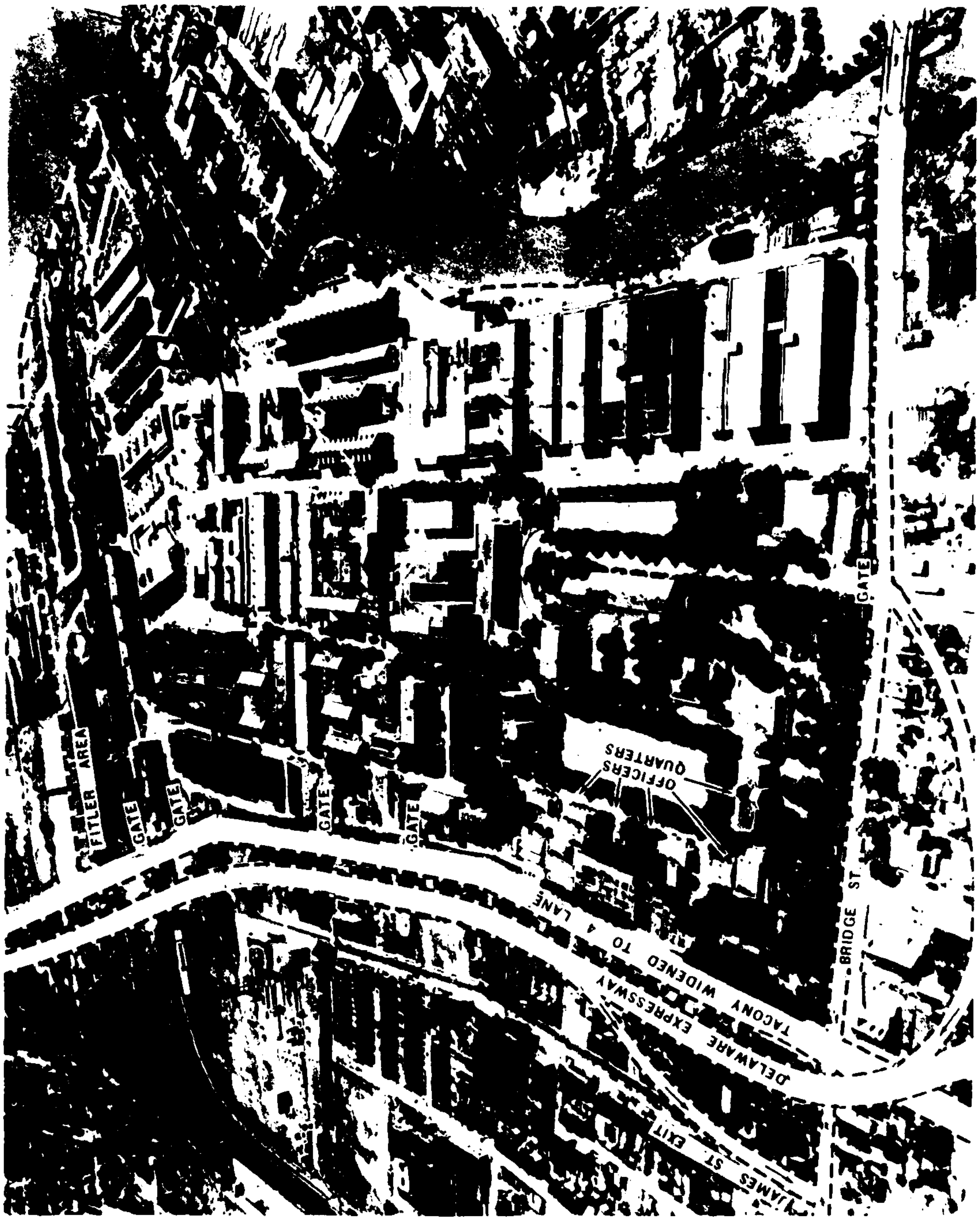


Figure I-1. FRANKFORD ARSENAL

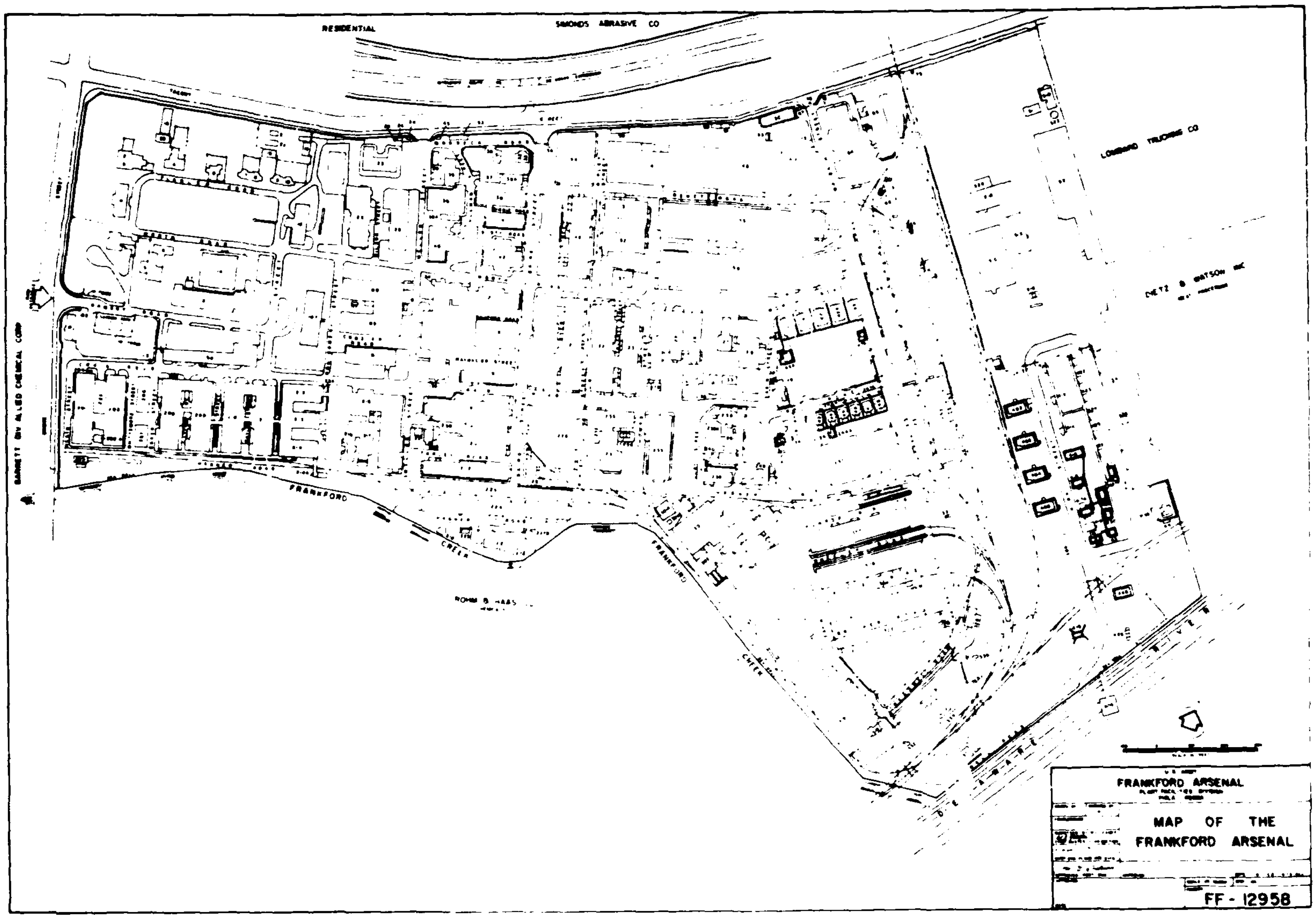


Figure I-2. MAP OF THE FRANKFORD ARSENAL.

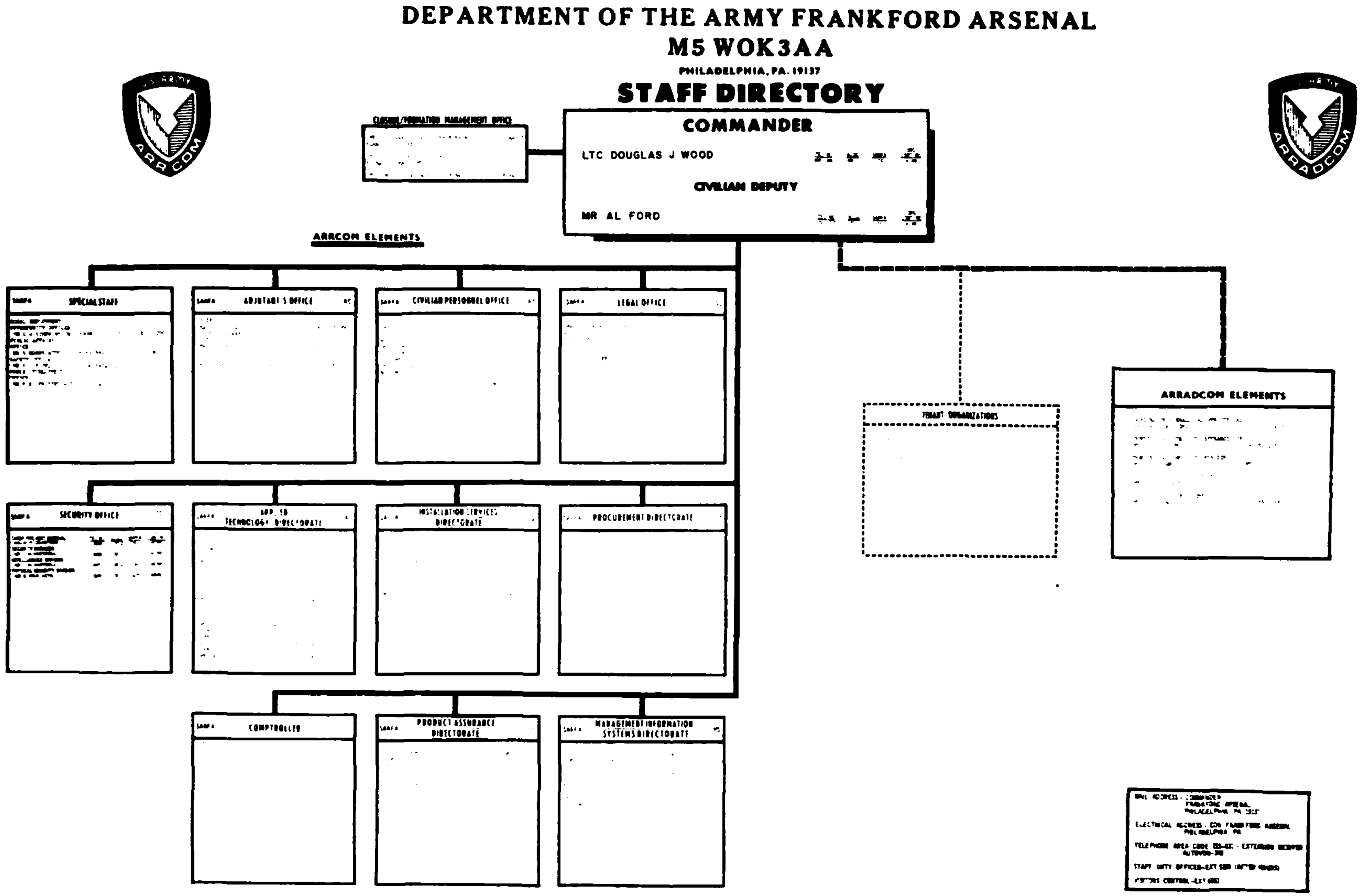


Figure I-3. ORGANIZATIONAL CHART, FFA.

c. Performed national procurement for assigned commodities and for fire control material.

d. Performed support mission responsibilities for fire control material in support of US Army field units.

e. Performed national industrial mobilization planning for assigned procurement items.

f. Executed technical management for the non-international portion of the US Army standarization program.

g. Conducted centralized AMC training.

h. Provided laser technology, physical science, engineering and other RD&E related investigations, and consultations on the biomedical effects.

i. Provided administrative and logistical support to installation mission elements and tenant activities on the installation.

During the more prosperous years, FFA was considered the small arms ammunition capital of the country, producing not only munitions for military use but match ammunition for civilian competition.

4. History

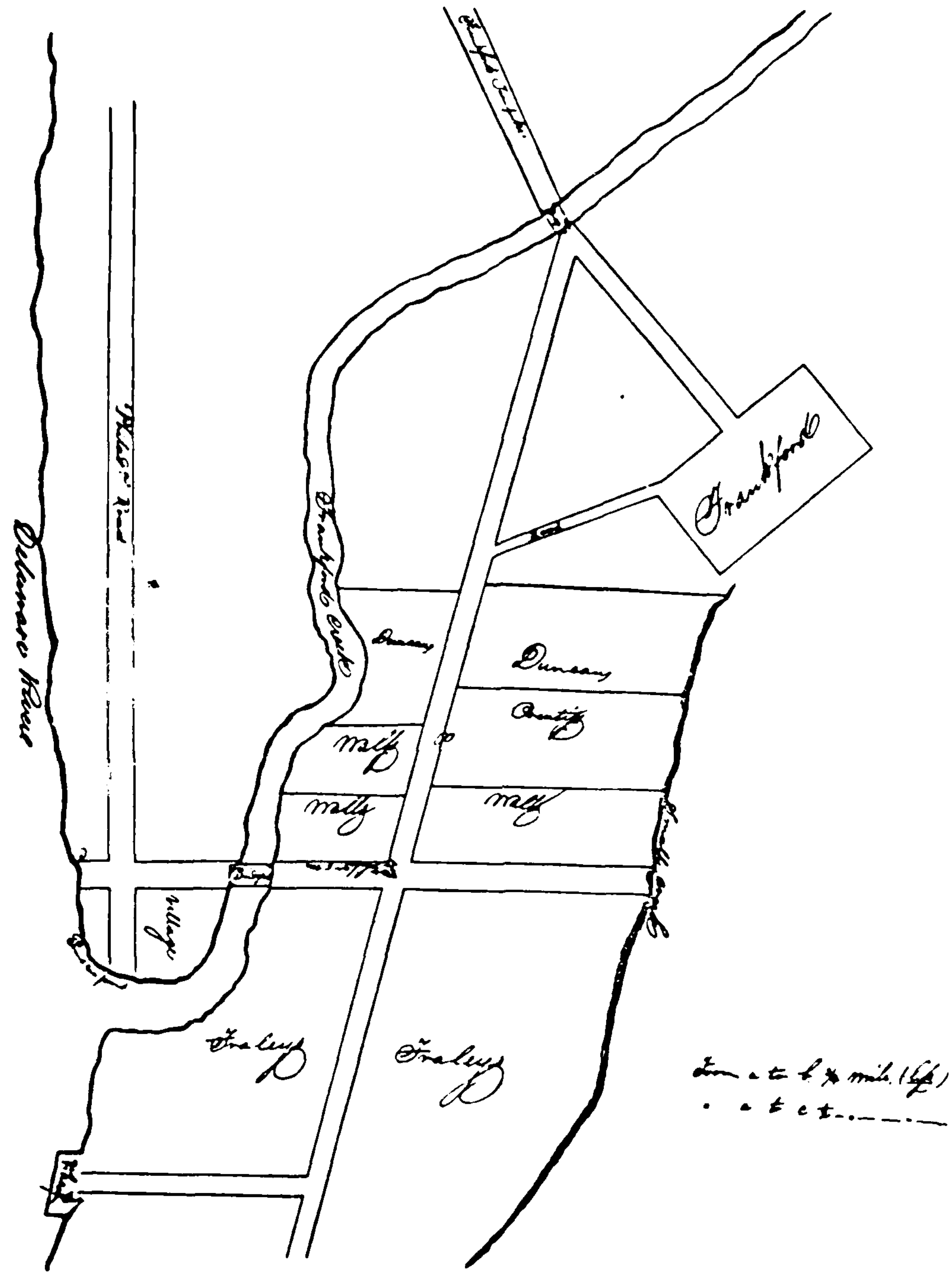
The War of 1812 developed a need for an arsenal. Two months after war was declared, Philadelphia was mentioned as a possible location; thus the beginning of FFA. The land that now constitutes FFA is believed to have been the site of an Indian encampment, perhaps as late as 1755.

Reorganization of the Ordnance Department by the Act of February 8, 1815, included the mission to establish depots in various parts of the country. Consequently, the first formal acquisition of land for FFA began on 27 May 1816, when the Assistant Commissary General, Colonel George Bomford, procured for the Government a tract of land -- 20.21 acres from Frederick and Catherine Fraley for the sum of $7,680.75 (see Figures I-4 and I-5). This purchase date is the approved birthday of Frankford Arsenal (then the US Arsenal of Frankford Creek).

The second acquisition on 8 April 1837 of 3.03 acres was for $3,000.

The third acquisition on 27 December 1849 added another 38.98 acres at a cost of $20,000.

The fourth acquisition of 28.26 acres on 2 March 1917 was for the purchase price of $125,000.



Map of site near Frankford Creek accompanying correspondence from Col. Wm. Linnard, Philadelphia, to Col. George Bomford, Ord. Dept., City of Washington, dated 19 Sept. 1815

Figure I-4. MAP SITE NEAR FRANKFORD CREEK, 19 SEPTEMBER 1815.

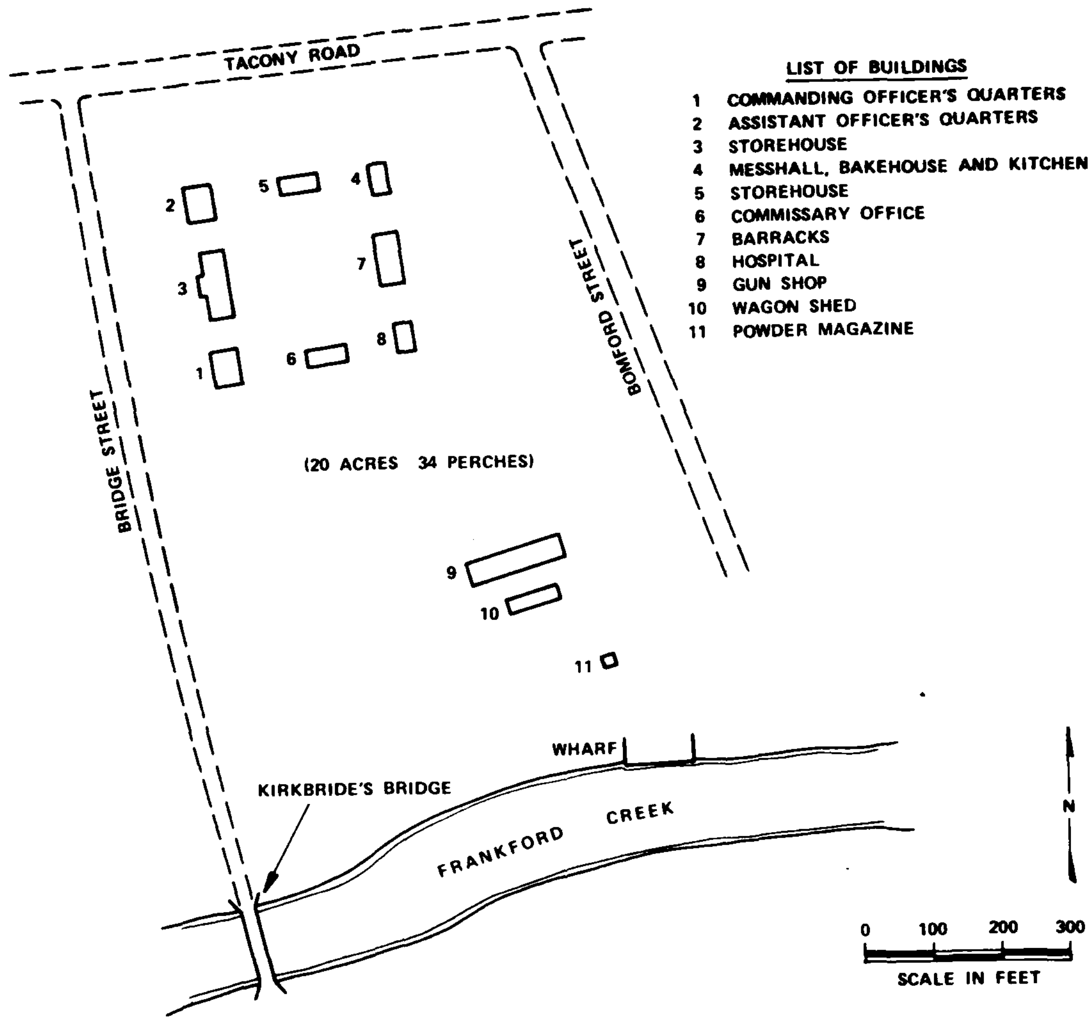


Figure I-5. FRANKFORD ARSENAL, 1832.

The last two purchases were from the Edwin H. Fitler Company; 8.84 acres on 10 May 1943 for $130,000 and 8,66 acres on 13 August for $140,000.

Captain Joseph Rees reported on 16 December 1816 that the barracks were completed and the wharf was also completed and receiving stone. Congress, having failed to appropriate money, stopped construction on 21 March 1817. Instructions were also issued to discharge all but the very essential personnel. This is recorded as the first Arsenal RIF (reduction-in-force).

During the intervening 15 years, considerable construction was accomplished; reports indicate the Arsenal was completed in 1830.

Until the war with Mexico in 1846, the chief Arsenal activities were repair of artillery and infantry equipment, proving and testing musket and rifle powder, and as a general storage and distribution depot for ammunition, small arms, artillery, and cavalry equipment. From the Mexican War to the Civil War, the Arsenal engaged mainly in storage, preservation, and repair of ordnance stores, fabricating small quantities of ammunition and other miscellaneous items.

Also during the early 1850's the variety of products increased to include 12-pounder wads, flannel cartridge bags, percussion muskets, tangent scales for howitzers, instruments for inspecting cannon projectiles, ring gages, gravimeters, and Burnside's metallic cartridge cases. This established the precedence for small arms ammunition and precision instrument manufacture.

Just prior to the Civil War, the first power driven machinery was introduced into FFA in March 1853 and was utilized for the manufacture of percussion caps, bullets, cartridges, and other small arms ammunition items. The personnel complement at that time consisted of 1,550 people. At the close of the Civil War, this dropped to 550.

In 1865 center fire cartridges were developed and, in October 1866, manufacture began of cartridge cases for caliber .50 service ammunition.

Just prior to the Spanish American War, the first research work on smokeless propellants was begun at the Arsenal. In 1894, the Arsenal initiated research work in explosives. Captain Dunn developed the explosive known as "Dunnite," a variation of which was Explosive D (ammonium picrate) utilized by the military as recently as World War II. During the Spanish American War, we find not only research but development work going on in the fields of small arms ammunition and fire control instruments as well as in artillery ammunition. It was still recognized as an important production facility for artillery ammunition components, fire control instruments, and small arms ammunition, producing small arms ammunition at the rate of 37 million rounds per year.

During World War I, the small arms ammunition production increased to 60 million rounds. Reports from the field, and tests conducted elsewhere, proved the Arsenal's ammunition superior to all others. Therefore, the Arsenal manufactured all caliber .30 tracer, incendiary, and armor piercing ammunition for the Army and Navy aircraft. The Arsenal produced 232 million rounds during the period of January 1917 through November 1918. Difficulties hampered early production of cases and primers. Primers were found to be defective and a new primer, the Frankford Arsenal #70, was developed.

During this period millions of rounds of artillery ammunition, including shrapnel and high explosives, were manufactured, loaded, and shipped. However, as production mounted, recurring explosions of primers endangered the neighbor residents. Areas surrounding the Arsenal, once sparsely settled, had become densely populated. Consequently, for safety, loading at the Arsenal was discontinued and moved to less populated areas.

During World War II, greater emphasis was placed on caliber .50 ammunition. Approximately 1,386,000,000 rounds of service ammunition were produced from January 1942 through August 1945.

The Arsenal was heavily involved in research and development work in the commodity areas of fire control instruments and small arms ammunition, and to some extent artillery ammunition projectiles and cartridge cases. The small arms ammunition production increased to a rate of 8 million rounds per day. The personnel complement of FFA at the height of World War II was 22,000 people. This dropped at the end of World War II to approximately 6,850.

Production experience during World War II made it imperative that gages be designed to insure the interchangeability of all future manufactured material. Frankford's gage mission was expanded to cover gage design and inspection equipment for all small arms ammunition, artillery ammunition, and fire control materiel.

Although early history of the Arsenal refers to a "laboratory," laboratory work, as presently understood, began in 1864. In April of that year, after discussion with the DuPont Powder Company, Captain Theodore T. S. Laidley, the Arsenal's 17th commander, conducted experimental tests on the effect of powder explosions on the iron framework of buildings. The Laidley Laboratory was built in 1868. In 1896, Mr. Williams became the Arsenal's first chemist. In July 1906, he was granted Patent No. 825,168 for progressive burning smokeless powder, a development as sensational as smokeless powder itself. From 1900, the Arsenal laboratory was regarded as the most knowledgeable source of information on the subject of explosives in the United States. All commercial and government agencies consulted and used its facilities. During World War I, the laboratory supervised explosives manufacture and handling, developed and standarized armor piercing bullets, cartridge cases, and compositions for tracer bullets. In 1934 the laboratory became the non-ferrous metallurgy center for the Ordnance Department.

FFA shops were recognized authorities in the United States for optical, electronic, mechanical, hydraulic and propellants production engineering. The optical shops produced optical, ranging, sighting, and observation equipment. Complete facilities for producing pilot runs of ammunition ranging from caliber 5.56-mm rounds to 155-mm projectiles were maintained in the ammunition shops. These, together with auxiliary shops, were capable of producing complete integrated guidance and control portions of weapon and missile systems, small arms and major caliber ammunition, metal components, and propellants. Facilities were available for the loading and testing of explosives.

From July 1958 to July 1964 the Supply and Maintenance Group, formerly a division of Fire Control Instrument Group, planned and controlled the national maintenance of fire control materiel, related equipment, and special devices.

VT fuze* activities, a former FFA mission for many years, have been transferred elsewhere. Experimental fuzes, both electromechanical and electronic, for missiles, rockets, and artillery were developed, debugged, and readied for industrial mass production.

Notable FFA achievements were the development of recoilless weapons system which placed artillery fire power in the hands of the infantry; cartridge actuated devices providing escape systems for aircraft personnel; spiral wrapped cartridge cases which used less critical material; small arms cartridge cases; welded over-lay rotating bands which increased projectile production quantities; and the casting of titanium, a critically needed metal developed for effective military use.

The Army-wide reorganization of 1962 brought FFA under the control of US Army Munitions Command, a part of the Army Materiel Command (AMC) complex, as part of a move to decentralize field operations.

Effective 1 July 1964, the National Inventory Control Point for Fire Control Spare Parts and Fire Control Maintenance functions were transferred to the Weapons Command (WECOM). These functions were accomplished by personnel physically located at FFA but under the control of WECOM. In July 1971 the entire National Inventory Control Point was transferred to New Cumberland Army Depot, New Cumberland, Pennsylvania.

As a result of the FFA realignment, many changes were effective 1 May 1965. Pitman-Dunn Research Laboratories were comprised of the Objectives Analysis Office, Resources Office, and the Physics Research, Metallurgy Research, and Chemistry Research Laboratories. The former Pitman-Dunn Institute for Research was incorporated into the Pitman-Dunn Research Laboratories.

*Also known as veritable time or proximity fuze

Following AMC's reorganization along the lines of a standard commodity concept in May 1970, MUCOM directed that FFA develop a proposed reorganization along those lines. This was initially accomplished in July 1970. Further refinements and minor internal modifications were made up to early 1971.

Under the influence of the closure action, the Arsenal, now under ARRADCOM, reduced its personnel during FY 76 from 3,324 to 2,667. With the trend accelerated during early FY 77 it is well on its way to complete closure as an active installation by the end of the fiscal year.

Thus ends the 161 year history of what was the second oldest active arsenal in the country.

E. Environmental

1. Water Quality

a. Surface. FFA obtains its water from the city of Philadelphia. This is discussed in Chapter II, section F1, Water Supply. Surface drainage from precipitation is collected by a system of road drains and discharged to either the Delawa River or Frankford Creek through the storm drainage system.

The Delaware River passes along the southeast boundary of FFA. Frankford Creek flows along the southern boundary of FFA and discharges into the Delaware River. In recent times the flow in Frankford Creek has been diverted along another route. Because of this diversion the abandoned creek bed has become a backwater of the Delaware River. This backwater extended up the former creek bed to Bridge Street and is referred to as the Frankford Creek Ditch.

b. Subsurface. The groundwater at FFA exists under water table conditions and occurs at depths ranging from 3 to 24 feet. Although an artesian system exists in property adjacent to FFA (see Figure I-6), it is absent from the subsurface of FFA, as shown in Appendix C. At the present time, groundwater is not used at FFA.

Recharge to the groundwater system comes from precipitation falling on the ground surface of the Arsenal. The regional pattern of groundwater movement is from the highest area on the Coastal Plain, near the Fall Line, toward the Delaware River. Discharge from the groundwater system flows into the Delaware River, although the tidal nature of the river affects the flow rate near the river.

The Philadelphia District Corps of Engineers indicated a stream channel which extends from building 64 south to building 301A that has been covered with fill. Groundwater levels in the area indicate groundwater flow through the abandoned stream channel.

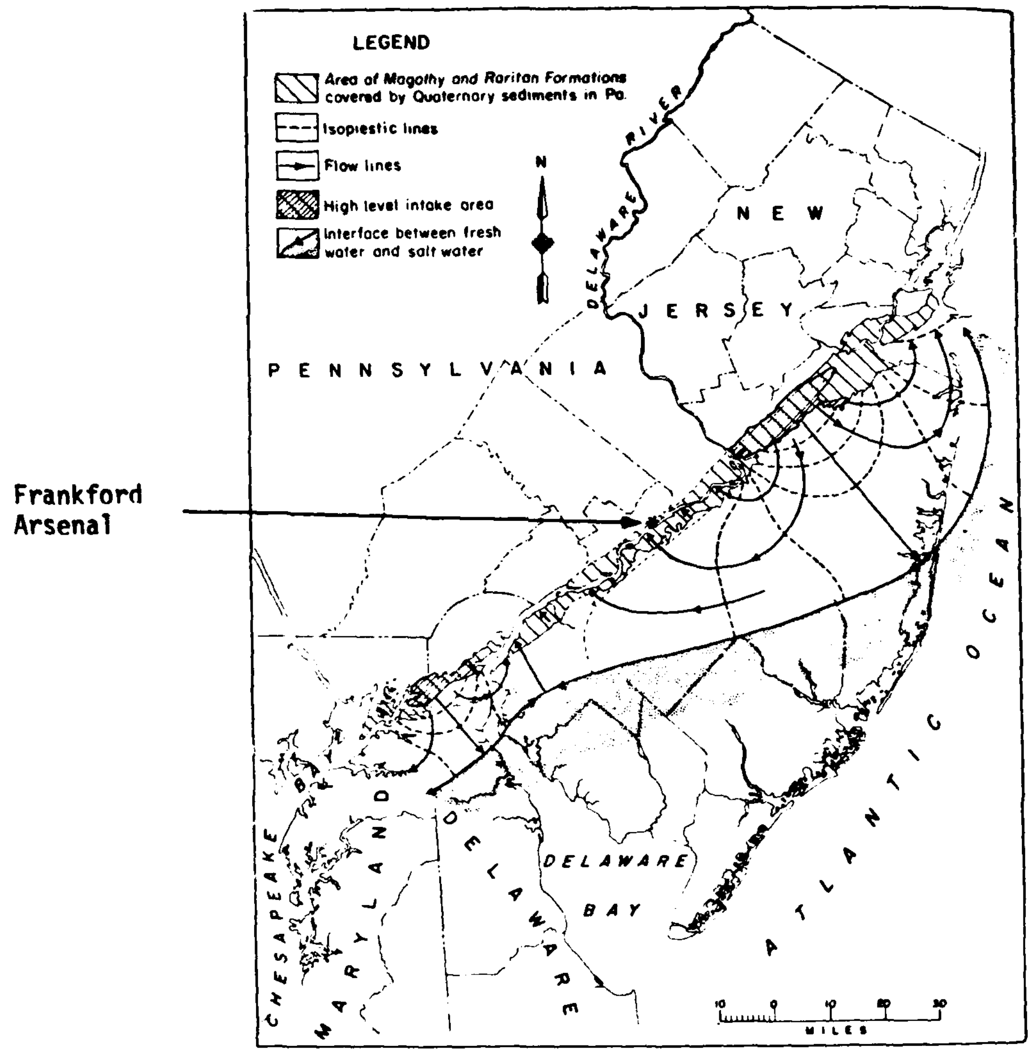


Figure I-6. GROUNDWATER MOVEMENT – ARTESIAN SYSTEM.

A spring is located in a service tunnel between building 301 and building 235. Another spring located "behind the hospital" was used for drinking water according to an article in the FFA bulletin dated 14 October 1944. No further information for this spring was available. A well was drilled at FFA in 1907 for an undetermined use; however, the well has since been destroyed. Water quality information for these water sources is not available.

c. Analysis. A Water Quality Engineering Special Study Number 24-029-73/75 on Industrial Wastewater was conducted at FFA from 13 - 27 August 1975. Analysis of physical and chemical parameters showed that concentrations of these parameters in the sanitary-industrial wastewater discharged to the Philadelphia sewer system were well below the standards set by the current regulations in effect at that time governing disposal of wastewater to the Philadelphia system. Periodically, the pH of the wastewater being discharged was below the required minimum of 6.0 pH units. These excursions were caused by acid dumps from the industrial processing areas. Proper neutralization of the batch dumps or slower bleed-in of the wastewater was recommended to eliminate these excursions.

Process (tap) water analyses results showed a large variation in the pH and total dissolved solids.

Concentrations of the analyzed parameters in stormwater discharged to Frankford Creek Ditch showed increased dissolved solids due to the evaporation of water utilized in once-through cooling and then discharged to the storm drainage system.

Currently, one sample of wastewater is taken weekly from the sanitary sewer and the storm sewer to be analyzed. See Table I-1 for results of these samples.

2. Natural Resources

Frankford Arsenal's land area consists of 24 improved [illegible] semi-improved acres, and 86 unimproved acres. Because of [illegible] little or no data on land, forest or fish and wildlife management.

According to the Environmental Impact Assessment of FFA, dated [illegible] tember 1975, the Arsenal is "located in a highly industrial area [illegible] its operation has no effect on the ecology of the area.

FFA vegetation is primarily lawn and trees. The following [illegible] taken from a paper, "Through the Years Since 1814," dated [illegible]

"About 1854 Commodore Matthew Perry came from the Orient to visit his brother-in-law, Major Hagner, who was then in command at Frankford Arsenal. He brought as a gift a dozen

TABLE I-1. CHEMICAL ANALYSIS -- WATER SAMPLES*

Date Sample Taken(1977)	pH	Cr+6	Ni	Cr Total	Zn	Cd	Cu	Ag	Cn	PO_4 as (P)	COD	Oil
Sanitary Sewer, Bldg 224												
19 May	7.2	<.005	.008	<.005	.052	<.002	.012	<.002	<.002	.24	15.0	4.8
25 May	7.1	<.005	<.002	<.005	<.005	<.002	.020	<.002	<.002	8.00	600.0	22.0
6 Jun	6.75	<.005	.005	<.005	.103	<.002	.008	<.002	.009	.39	5.0	1.2
20 Jun	7.09	<.005	<.005	.008	.121	<.002	.070	.002	<.002	.48	37.0	10.0
Storm Sewer, Bldg 218												
19 May	6.8	<.005	.005	<.005	.032	<.002	.013	<.002	<.002	.09	4.8	5.2
25 May	9.0	<.005	<.002	<.005	<.005	<.002	.060	<.002	<.002	15.00	45.0	20.0
6 Jun	8.35	<.005	.082	.133	.068	<.002	<.002	.007	.018	2.40	2.9	3.7
20 Jun	7.22	<.005	.008	.008	.207	.003	.143	.002	.002	.15	20.0	7.2

*Both sets of water analysis were completed by E. L. Conwell Company, 2024 Arch Street, Philadelphia, PA 19103. All readings are in parts per million except for pH.

seedlings of the rare Empress of India (Paulownia) trees. Nourished and cherished for nearly a hundred years, these trees have grown to great height and diameter. Each May the trees with dozens of their seedlings wave their purple, plume-like clusters of blossoms which fill the boughs before the leaves appear." See Figure I-7.

A list of the 27 different trees was obtained from the General Tree Cover Map of FFA and is given in Table I-2.

TABLE I-2. TREES ON FFA

Maple	Princess (Empress of India)
Birch	Plane
Dogwood	Cherry
Hawthorne	Peach
Beech	Plum
Ash	Flowering Cherry
Ginkgo	Pear
Holly	Oak
Walnut	Locust
Kocheuteria	Sassafras
Magnolia	Arbor Vitae
Apple	Elm
Flowering Crab	Sauleaf Zelhova
Mulberry	

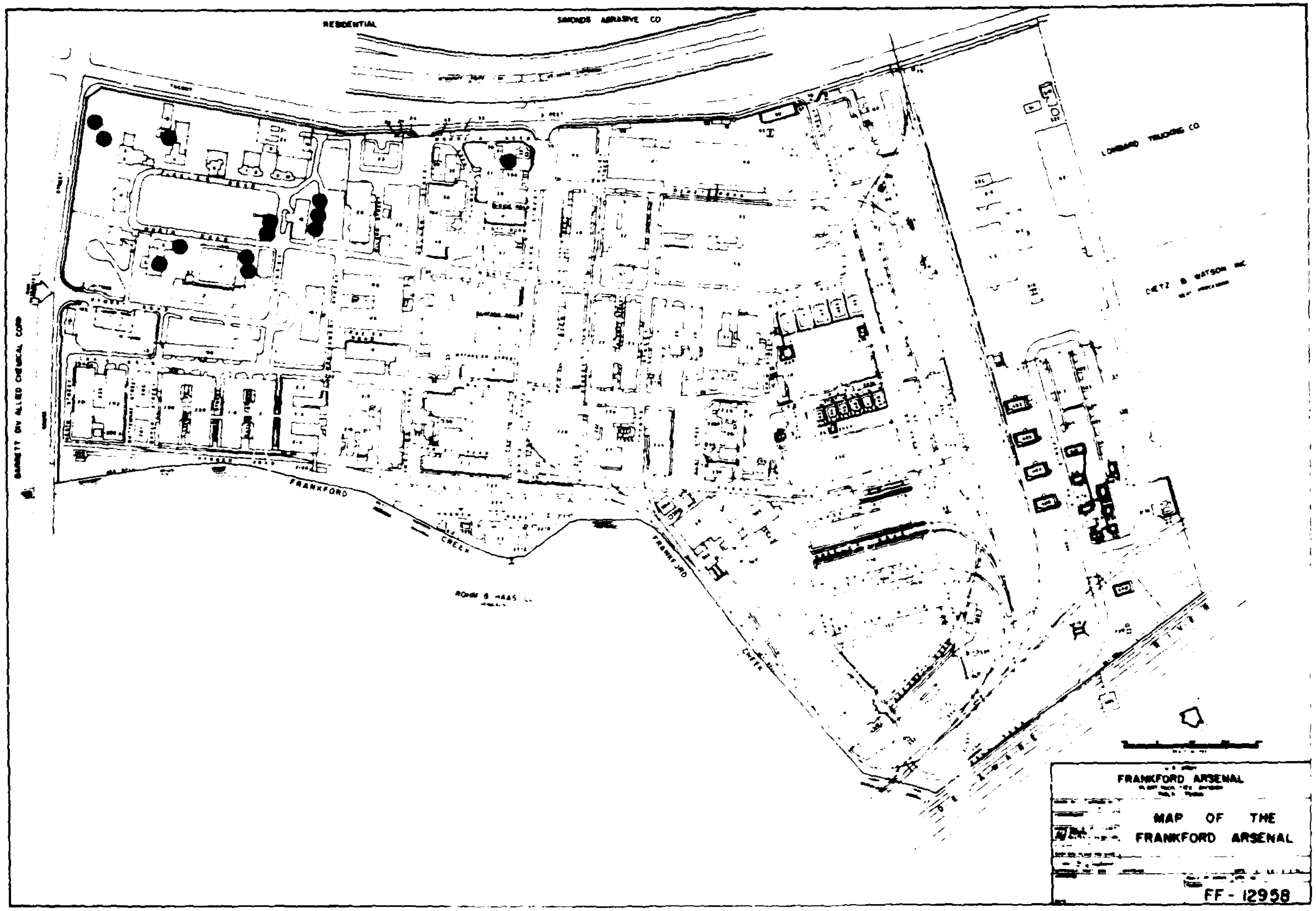


Figure I-7. LOCATION OF "EMPRESS OF INDIA" TREES.

3. Geology

a. Physiography and Topography. FFA lies in the physiographic province of the Coastal Plain, directly southeast of the boundary between this province and the Piedmont province. See Figure I-8. This inner or landward margin of the Coastal Plain is called the Fall Line, and is identified topographically by an abrupt transition from the rolling hills of the Piedmont to the flat lowlands of the Coastal Plain. The Penn-Central railroad tracks directly north of FFA follow the Fall Line.

The topographic differences between the two provinces reflect the differences in composition and structure of the rock materials underlying their surfaces. The Piedmont is underlain by dense, hard crystalline rocks that offer considerable resistance to erosion and support an uneven hilly surface, which stands well above the general level of the adjacent Coastal Plain. The Coastal Plain is underlain by soft, unconsolidated deposits that yield readily to the processes of erosion and form low nearly flat plains and broad shallow valleys.

The land surface has a gentle slope from the Fall Line southeast to the Delaware River. The general level of the land surface rises from sea level along the river to about 40 feet above mean sea level (msl) at the Fall Line. The highest elevation on FFA is 20 feet msl in the northwest portion of the Arsenal.

b. Subsurface Geology. In general, the geology of the Coastal Plain area of southeastern Pennsylvania can be described as Quaternary and Cretaceous sediments overlying a basement of early Paleozoic rocks. A generalized stratigraphic section of the Coastal Plain of southeastern Pennsylvania is given in Table I-3.

Bedrock consists of pre-Cretaceous mica schist which is at a depth of 26 feet at the northern boundary and 64 feet at the southeastern corner of the Arsenal. The bedrock is overlain by unconsolidated sand, gravel, silt, and clay of Cretaceous age. Quaternary sand, gravel, silt, and fill overlie the Cretaceous sediments and outcrop on the surface of the Arsenal. Specific site information for the subsurface lithology at FFA is in Appendix C.

c. Soils. All soil on FFA is classified as Urban land by the Soil Conservation Service. These soils formed in loamy and clayey material of the Coastal Plain sediment. The Urban land is a land type that consists of areas that are built up and occupied by urban structures and works. Most of the FFA soils have been smoothed, disturbed, or filled in prior to construction of Arsenal facilities. At the present time, much of the soil surface is obscured by buildings and pavement.

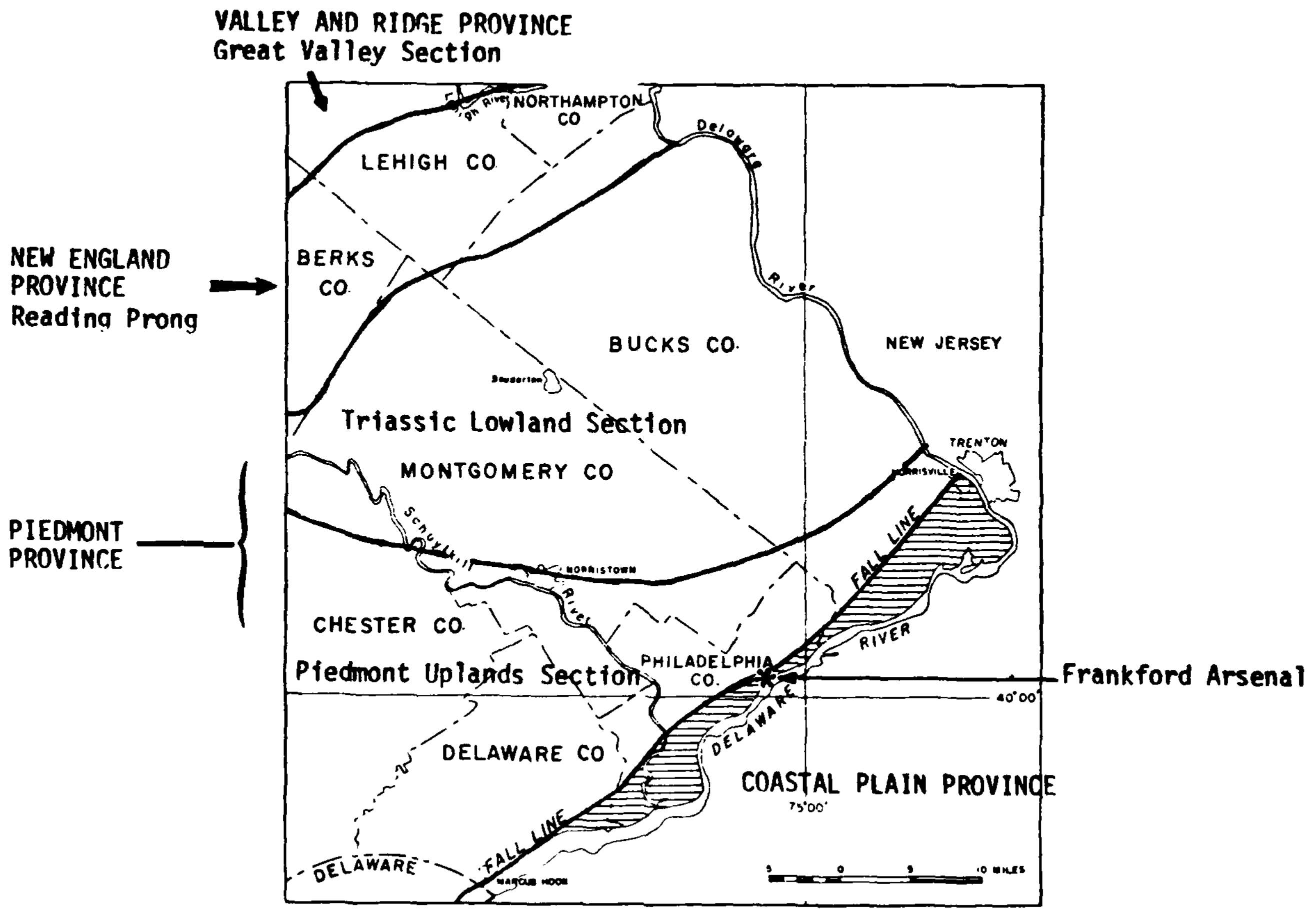


Figure I-8. PHYSIOGRAPHIC PROVINCES MAP OF SOUTHEASTERN PENNSYLVANIA.

TABLE I-3. GENERALIZED STRATIGRAPHIC SECTION OF THE COASTAL PLAIN OF SOUTHEASTERN PENNSYLVANIA

Geologic Age: System	Geologic Age: Series	Formation and Member	Sym-bol	Max Thick (ft)	Physical Character	Water-bearing Character
QUATERNARY	Recent	Alluvium	Qal	72	Flood plain and channel deposits of clay, silt, sand, and some gravel	Not important as a source of groundwater; generally less permeable than underlying deposits; impedes the movement of water into and out of surface streams
		---- Unconformity ----				
	Pleistocene	Cape May Formation (Illinoian) ---- Unconformity ---- Pensauken Formation (Illinoian)	Qcm	80	Chiefly gray and brown sand and gravel; some silt; little clay. Cape May unweathered. Pensauken deeply weathered	Important source of groundwater in SE Bucks County. Contains highly permeable sand and gravel beds which yield large quantities of water to wells. Favorably situated with respect to recharge; subject to surface contamination
		---- Unconformity ----				
CRETACEOUS	Upper Cretaceous	Magothy Formation	Km	10	Medium to coarse gray sand with plant remains	Unimportant as source of water in PA owing to its small aerial extent
		---- Unconformity ----				
		Upper Clay Member	Kru	35	Chiefly red, white, gray, and yellow clay. Also brown and blue clay; silty, sandy and pebbly in places	Acts chiefly as a confining bed
		---- Unconformity ----				

TABLE I-3 (continued)

Geologic Age: System	Geologic Age: Series	Formation and Member	Symbol	Max Thick (ft)	Physical Character	Water-bearing Character
CRETACEOUS	Upper Cretaceous	Raritan Formation: Old Bridge Sand Member	Kro	55	Chiefly brown, gray, white, and yellow sand with some gravel; contains some clay and silt in Bucks County	Excellent aquifer; forms extensive water table aquifer interconnected with the Pleistocene sediments. Generally not tapped by wells in areas where it occurs beneath an upper confining bed
		--- Unconformity ---				
		Middle Clay Member	Krm	60	Chiefly red and white clay; also gray, yellow, blue, and brown clay; sandy in places	An extensive confining bed
		--- Unconformity ---				
		Sayreville Sand Member	Krs	49	Chiefly brown, yellow, white and gray sand and gravel; little clay	Generally not tapped by wells. Potentially an important aquifer in Bucks County
		--- Unconformity ---				
		Lower Clay Member	Krl	61	Chiefly red clay, also gray, blue, white and brown clay; sandy in places	An extensive confining bed
		--- Unconformity ---				
		Farrington Sand Member	Krf	87	White, yellow, gray, and brown sand and gravel; some white clay	Principal source of groundwater in Phila area; avg permeability 1000 gpd/sq ft as determined by pumping tests. Yields 500-1000 gpd to wells in South Phila
		--- Unconformity ---				
PRE-CRETACEOUS	Glenarm	Crystalline Rocks	P	?	Mica schist capped by residual weathered clay	Poor aquifer in Coastal Plain area; contains some groundwater in secondary fractures; avg yield less than 50 gpm

The physical and chemical properties of Urban land are not available through the Soil Conservation Service because these properties are too variable to estimate.

The general composition of the soil and unconsolidated sediments are shown in Appendix C. These indicate fill material in 36 of 56 boreholes within the Arsenal. The Philadelphia District Corps of Engineers estimates that a strip of land approximately 300 feet wide, adjacent to Frankford Creek and the Delaware River consists of large amounts of fill material.

II. CONTAMINATION ASSESSMENT

A. Industrial and Manufacturing Operations

1. During the 161 year history of FFA, production has involved many diverse end items. The net result is the potential for wide-spread contamination due to explosives, pyrotechnics, incendiary materials, propellants, corrosives, toxic compounds, radioactive material, heavy metals, and metal treating and plating materials. A brief synopsis of such materials is presented below:

Carcinogens:

Benzene
"Tris" flame retardant
Benzidine
Polynuclear hydrocarbons

Heavy Metals and Heavy Metal Salts: (Note some are also suspect carcinogens)

Lead and salts
Cadmium and salts
Arsenic oxide and salts
Platinum group metals and salts
Silver and salts
Gold and salts
Barium salts
Copper and salts
Antimony and salts
Chromium salts
Depleted uranium
Mercury (large quantities) and salts
Bismuth salts
Selenium
Cerium oxide
Strontium salts

Unique Toxic Gases and Chemical Agent Intermediates

Carbonyl chloride (phosgene)
Nickel carbonyl
Methane difloro phophine oxide (difloro)

Explosives, Pyrotechnics, etc.

Nitroglycerine
Live ammunition
Experimental tetrazoles
Organic peroxide
Nitrocellulose
Zirconium powder
Lead styphnate
Black powder and ammunition propellants
PETN
Denitrotoluene
RDX
Tetracene
Barium nitrate
Aluminum/magnesium powders
Unidentified experimental propellant, flare, and incendiary mixes
Thermite mix
Red phosphorus
Nitrate salts
Trinitrorescorcinal
Inorganic peroxide, persulfates, and perchlorates
Teflon based pyrotechnics

Corrosives

Alkaline

Sodium hydroxide
Soda ash (sodium carbonate)
Sodium hypochlorite
Lime
Cyanide salts
Ammonium hydroxide

Acid

Hydrofluroic
Hydrobromic
Nitric
Sulfuric
Sodium dichromate
Hydrochloric
Chromic
Phosphoric
Acetic
Formic

Solvents: Full range of organic solvents were found. Some examples are:

- Acetone
- Methyl, ethyl, etc. alcohol
- Ketones
- Toluene
- Benzyl alcohol
- Chlorinated hydrocarbons (carbon tetrachloride, etc.)
- Cellosolves
- Ether
- Zylene
- Paint thinners and strippers
- Dioxane
- Petroleum ether
- Proprietory metal degreasers
- Napthalene
- Enamel thinners

Other Materials:

- Metal treating and plating materials (e.g., zinc phosphate)
- Paints and lacquers
- Chlorinated napthalene
- Expoxy components and "potting" components
- Hydrogen gas cylinders
- Chlorine gas cylinders
- Ethylene glycol
- Acetylene tanks
- Powdered beryllium
- Difloromethane cylinder
- Anhydrous ammonium cylinder
- Vast quantities of laboratory and experimental organic and inorganic chemicals

2. Description and Size (400 Area)

The 400 Area is a nine-acre section of FFA located in the lower northeast end of the post. The land was acquired in 1943 and is also known as the Fitler Area, after the former owner. The area is fenced and contains 32 buildings located along Phillips and Kirk Streets (see Figure II-1). The lead styphnate manufacture was started in 1944 and was deactivated in 1974. The facility includes approximately 8,200 feet of contaminated terra cotta drain lines from the waste sumps associated with the buildings. A contaminated building list for this area is presented in Table II-1.

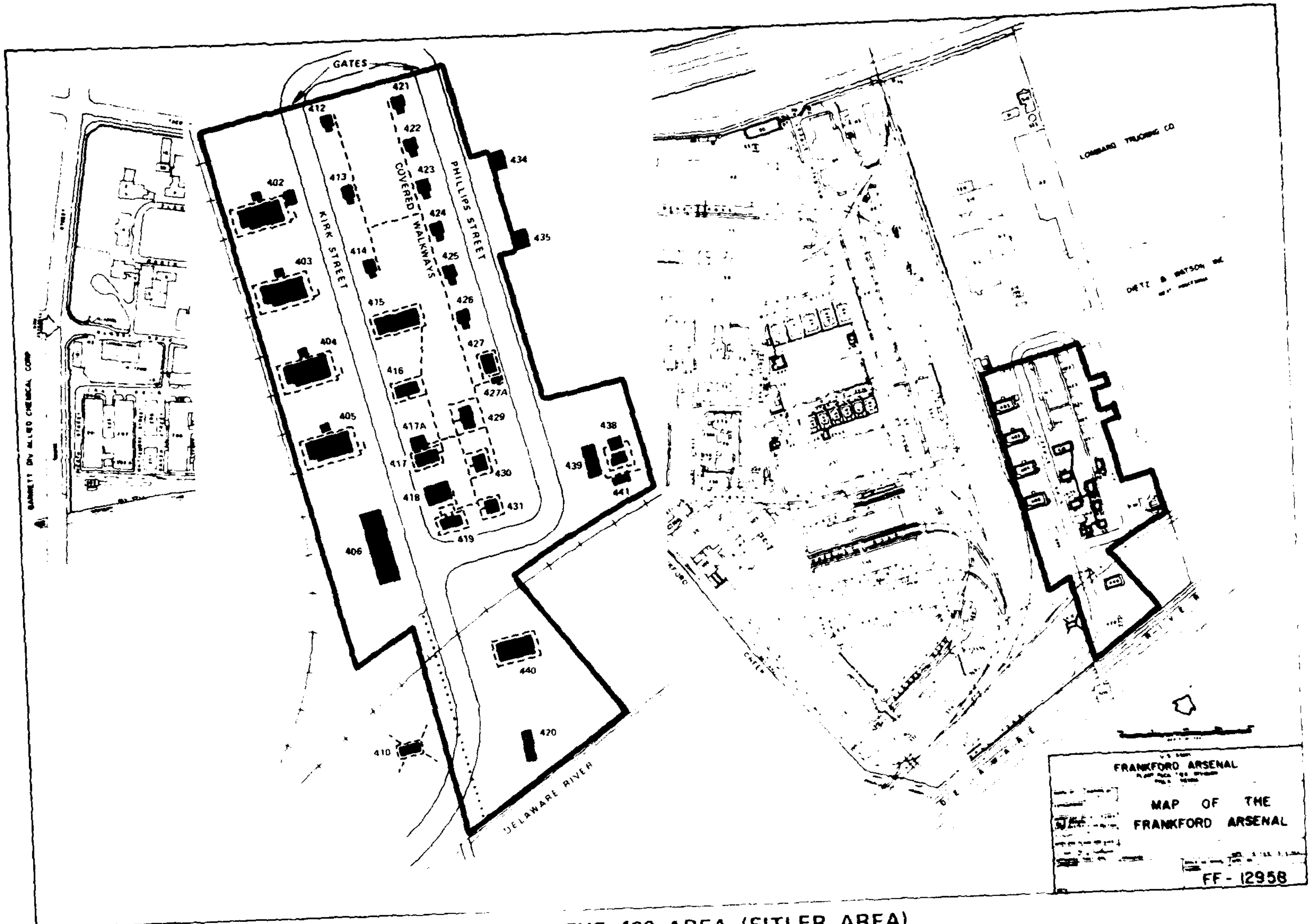


Figure II-1. THE 400 AREA (FITLER AREA).

TABLE II-1. CONTAMINATED AREAS WITHIN FFA

Bldg	Activity	Contaminants
46-1	Plating shop	Acids and corrosives
47	Prototype metal parts, mfg and fab	Acids, corrosives, paints, lacquers, etc.
48	Heat treat and forge	Acids, corrosives, treating salts, petro products
48-N Outside	Bulk storage tank	Sulphuric acid
55-1&2	Shell shop and tool room	Acids, corrosives, paints, lacquers, etc.
57	Health clinic	Medical supplies
58-1&2	Artillery case shop	Acids, corrosives, paints, petro products
58-SE Outside	Storage shed	Paints, lacquers, etc.
58-SE Outside	Scrap petrl underground collection tank	Waste petrl products
58-S Outside	Acid storage tank	Sulphuric acid
60	Bulk storage	Trichlorethelene, solvents, etc.
61	Bulk storage sheds	Acids, corrosives, solvents, etc.
63	Bulk storage tanks (2-10,000 gal)	Quenching oil
64 bsmt	Spectrographic lab Heat treating lab	Acids, solvents, etc. Salts, chemicals, etc.
64-1	Materials and metals lab (4 rooms) Analytical chem lab (4 rooms)	Acids, petrl products, solvents, etc. Organic/inorganic chem, acids, etc.
64-2	Chemistry lab (9 rooms)	Chemicals, acids, corrosives, etc.

TABLE II-1 (continued)

Bldg	Activity	Contaminants
64-3	Photo lab	Photo chemicals, solvents, etc.
68	Prototype pyrotechnic charging, T&E, and storage	Chemicals, acids, mercury, solvents, etc.
69	Explosive storage	High explosives
120	Surface treatment and finishing	Acids, corrosives, etc.
121	Metal parts (20 and 30 mm)	Acids, corrosives, etc.
122-2	Small arms loading, assembly, and pack	Primers and propellants
130	Insect and rodent control	Insecticides and pesticides
148	Ammo components storage	Propellant and explosives residue
148-A	Propellant process sampling/storage	Propellants
149	Pyrotechnic materials storage	Pyrotechnic compositions
150	Special component mfg and fab	Depleted uranium
151	Pyrotechnic materials research	Pyrotechnic compositions
151-A	Process storage	Pyrotechnic elements and parts, etc.
201-2	Fire control systems devel	Tritium
208-3	Small arms bullet charging	Tracer compositions
209-3	Special ammo loading and assembly	Propellants, black powder, etc.
212-2	Mercurous cracking	Mercury, acids, corrosives, etc.
212-3	Small arms primer inserts and storage	Primers

TABLE II-1 (continued)

Bldg	Activity	Contaminants
213-3	Special projects loading and assembly	Propellants and primers
214-A	Propellant storage	Propellants
214-3	Small arms cartridge loading	Propellants
215 Complex	Metal parts mfg and fab	Acids, caustics, corrosives, etc.
216	Lead core manufacture	Lead billets and cores
217	Tool hardening	Heat treat salts, acids, corrosives, etc.
222	Small arms primer mfg and and caseless ammo	Propellants and primers
227	Analytical inspection	Propellant grains
227-B	Bulk storage	Radioactive materials
229	Special items fab	Propellants, solvents, etc.
230/231	T & E of items	Solvents, gases, etc.
239 Complex	Tracer and igniter mfg	Tracer and igniter components
241	Caseless ammo storage	Class 7 propellants
242 Complex	Caseless ammo, research and fab	Class 2 and 7 propellants, solvents, etc.
244-A	Storage	Class 7 propellants
245/246	Storage	Propellants and chemicals
247	R&D operations	Chemicals related to propellant research
248	R&D operations	Propellants and compositions

TABLE II-1 (continued)

Bldg	Activity	Contaminants
249	Tracer mixes, storage	Tracers and compositions
250	Fuze assembly	Primers and components
305	Fuze test area	Completed fuzes
311	Fuze drop test tower	Completed fuzes
316/319	Ballistic research range and tower	Cartridges and propellants
332/334	Storage magazine	High explosives
337	Storage magazine	Class 2 propellants
339	Storage magazine	Nitroquanadine
402	Storage magazine	Primers
403	Storage magazine	Primers
404	Storage magazine	Propellants
405	Storage magazine	Primer composition
410	Storage magazine	Primer mix and RDX
412	Chemical storage	Zirconium, sodium carbonate
413	Blending operation	
414	Analytical lab	Zirconium, TNR, lead styphnate
415	Trinitroresorinol mfg	
416	Igniter processing	
417	Lead styphnate mfg	Sodium hydroxide, lead nitrate
417-A	Sample test burning	Wet composition and black powder
418	Igniter manufacture	

TABLE II-1 (continued)

Bldg	Activity	Contaminants
419	Final composition mixing	Lead styphnate
420	Storage	Black powder
421	Formerly TNT storage	Inert materials
422	Pyrotechnic materials mfg and mixing	Red phosphorus, magnesium, etc.
423	Pyrotechnic materials mfg pelletizing	Stabilized red phosphorus
424	Incendiary materials drying room	Pyrotechnic materials, IM-142 mix
425	Incendiary materials storage	Pyrotechnic materials, IM-23, IM-68
426	Chemical storage	Oxidizers
427	Tetrazene and PETN processing	Initiating type explosives
427-A	Interim storage	Various chemicals
429	Interim storage	PETN, tetrazene, etc.
430	Wet weigh-up	
431	Black powder drying	Black powder
434	Bullet and case break-up	Black powder
435	Bullet and case break-up	Black powder
438	Open burning pit	
439	Ammo and explosives incinerator	
440	Propellant distribution	Class 2 propellants
441	Holding area for Bldg 439	Primers, detonators, etc.
521	Small arms ammo test range	Small arms ammo, propellants, etc.

a. Primer Manufacturing Process. The primary components of the primer mix are tetrazine (guanyl nitrosamino guanadine) and lead styphnate (mono hydrate lead salt of 2,4,6 trinitroresorcinol: styphnic acid). Both components were manufactured within the 400 Area.

Tetrazine was produced in building 427 via the batch precipitation reaction of sodium nitrite with amino guanadine bicarbonate solubilized in aqueous acetic acid. Using 60 liter vessels required approximately 24 hours to complete the reaction.

Lead styphnate was produced in building 417 using a process purchased from Olin Corporation. It was prepared in 60 liter containers via batch precipitation from a mixture of styphnic acid and lead nitrate - acetic acid solution. The normal quantity of lead styphnate obtained from each batch reaction was two pounds, which represented a 70 percent yield. The lead styphnate was stored (wet) in building 430.

Styphnic acid was produced in building 415. The product was synthesized via a two-step process which consisted of the sulfanation of resorcinol in 30 liter batch nitrators, followed by nitration of the resulting product with nitric acid and anhydrous sodium nitrite. (The sodium nitrite had been freshly dried in an oven in building 414.) Styphnic acid was recovered, packaged in wooden boxes, and stored in building 416A.

The weigh-up of the lead styphnate and tetrazine was performed in building 430, in preparation for the blending which took place in building 419. The final blending of 700 grams of lead styphnate with 650 milliliters of tetrazine slurry, fuel, and oxidizer components (e.g., antimony sulfide, powdered aluminum, PETN, barium nitrate, and a light gum binder). The final mix was stored in building 410.

The disposal of the lead styphnate was initiated in building 418, the material was hydrolyzed with 50 percent NaOH, and the lead removed by the precipitation as lead acetate.

b. Propellants, Propellant Actuated Devices (PAD), and Cartridge Actuated Devices (CAD). Building 414 was the support analytical laboratory. The process for the auxiliary ignition for the PAD and CAD was conducted in buildings 414, 416, and 418.

In building 416, 120 grade zirconium powder (6.125 grams) was mixed with lead dioxide (18.125 grams) in distilled water. The mixture was then aspirated to remove the water. The material was then dryed in building 414. (It should be noted that the laboratory (building 414) was also involved in testing and experimental activities using nitrocellulose, nitroglycerine, etc.) The final mixture was prepared in building 418 where the zirconium-lead dioxide was combined with methylene chloride and a binder supplied by the Navy. The blend was then hand "painted" onto the ring-shaped cups. The propellant material was stored in building 440.

c. Pyrotechnics. Pyrotechnics were blended in buildings 413 and 422 in an Abby and a Lancaster blender respectively. Many specialized mixes were prepared using such materials as barium nitrate, magnesium and aluminum powders, potassium perchlorate, iron oxide, red phosphorus, strontium peroxide, strontium nitrate, strontium oralate, and calcium resinate binder. The materials were stored in buildings 425 and 426 (discrete chemicals). The incendiary materials were dryed in building 424 and 425 and the pyrotechnic materials were pelletized in building 423. The blending of experimental delay mixes was also a product of building 422.

d. Chemical and Explosive Storage and Support Buildings. Buildings 402, 403, and 405 were storage magazines for primer materials; 404 was used for propellant storage. All four buildings are currently in use, containing packed material awaiting transfer to Letterkenny Army Depot for disposal. Building 421 was used for TNT storage.

Building 412 was the chemical storage area for zirconium and sodium carbonate. Buildings 417B, 426, and 427B were used for the bulk chemical storage of the fuels or oxidizers utilized in the primer mix.

Commercial black powder was stored in building 431. It was also re-packaged into 12.5 pound quantities in this building. Building 420 was also used for powder storage.

Buildings 434 and 435 were the sites of bullet and case break-up.

"Building" 438 was an open burning pit and 439 was the area of the ammunition and explosives incinerator; building 441 is the collection point for scrap material awaiting incineration.

3. Frankford Arsenal was a commodity center for CAD, PAD, small arms ammunition (including incendiary and tracer), and time fuzes. Below is a list of potentially contaminated buildings:

Propellants		Pyrotechnics	CAD/PAD*
122	214	203	224
140	240	208	252
209	244		301A
212	245		304
213	246		319

For many of the older buildings utilized for small arms ammunition loading operations (220 series buildings) the operations were commonly conducted on the third (top) floor. These areas frequently lack floor drains to facilitate wash-down decontaminants.

*CAD/PAD devices use propellants

4. Chemical Contamination

Shortly after the completion of the records search, a team of chemists from the Chemical Systems Laboratory, Aberdeen Proving Ground, Maryland, were sent to FFA at the request of the Commanding Officer to remove laboratory quantities of chemicals from the various laboratories and the production area; and to consolidate these materials in a central site to facilitate eventual disposal. This site is the Pitman-Dunn Laboratory, building 64, and selected storage sheds. (See Appendix D.)

Heavy metals constitute the most widespread chemical contamination. In addition to lead salts used in the lead styphnate process and lead shot captured in the target butts of the various indoor ranges (e.g., buildings 150 and 521), possible residue from former outdoor ranges, and lead metal component manufacture in building 216 exist. Mercury and mercuric salts were used extensively. Quantities of mercuric oxide were used in the plating shop (building 46). The second floor of building 212 was the site of mercurous nitrate "cracking" tests for cartridge cases. The secure room of building 149 contained approximately 500 pounds of liquid mercury and various mercury amalgams. Building 68 is highly contaminated with mercury. The shed designated as building 61A was used as a storage site for the mercury collected during the consolidation. The small arms ammunition production sites and related storage and tests sites (see Table II-1) are areas of contamination resulting from the past use of mercury fulminate in ammunition.

The plating shop, building 46, is an area of significant contamination. A total of 144 tanks are located on the first and second floor. The tanks and their contents are listed in Table II-2.

In addition, commercial quantities of acids, alkali and plating, and degreasing materials are stored in the basement area. A support laboratory for the plating operations contained laboratory quantities of metals, metal salts, and plating test materials. However, the bulk of this material was removed during the consolidation exercise. To a lesser degree, the other buildings involved in metal treating operations have similar situations: buildings 47, 48, 55, 120, 216, and 217 process line contents are delineated in Table II-3. These buildings also have stocks of industrial chemicals stored on site.

As a result of the consolidation activities, the wide-spread distribution of laboratory reagent chemicals and solvents was rectified. During this chemical "roundup" the largest non-laboratory sources were the optical shop, building 108, whose stocks included substantial quantities of hydrofluoric acid (used in glass etching); and the plating laboratory mentioned in a previous paragraph.

TABLE II-2 (continued)

Tank No.	Plating Process	Use	Contents
25	Chromium	Copper plate	Sodium cyanide, copper metal in caustic solution
26		Cadmium plate	Sodium cyanide, cadmium metal in caustic solution
27		Cadmium plate	Sodium cyanide, cadmium metal in caustic solution
29		Water rinse	Water
30		Acid	Hydrochloric acid
31		Tin plate	Sodium hydroxide and tin metal caustic
32		Water rinse	Water
33		Water rinse	Water
34		Hot air	
35		Nickel strip	Sulfuric acid, concentrated
36		Nickel strip	Sulfuric acid, concentrated
37		Silver strike	Sodium cyanide, silver metal, copper in caustic solution
38		Silver plate	Sodium cyanide, silver metal in caustic solution
39		Nickel plate	Nickel sulfate, sulfuric acid, ac ' solution
40		Hot water bath	
41		Nickel plate	Nickel sulfate and chloride sulfuric acid, acid solution
42	Chromium	Copper plate	Copper sulfate and sulfuric acid, acid solution

TABLE II-2 (continued)

Tank No.	Plating Process	Use	Contents
43	Chromium	Electro clean	Alkali, caustic solution
44	Chromium	Water rinse	Water
45	Zinc, chromating and stainless steel passivation	Water rinse	Water
46		Water rinse	Water
47		Water rinse	Water
48		Water rinse	Water
49		Acid	Chromic acid, acetic acid, nickel sulfate and sulfuric acid
50		Electric clean	Alkali, caustic solution
51		Water rinse	Water
52		Acid	Hydrocloric acid, concentrated
53		Water rinse	Water
54A		Cyanide	Sodium cyanide solution, sodium hydroxide, caustic solution
54B		Nitrate stainless steel	Amonium nitrate solution
55		Zinc plate	Sodium cyanide, zinc metal in caustic solution
56		Water rinse	Water
57		Chromate	Sodium dichromate, sulfuric acid in acid solution
58	Zinc, chromating and stainless steel passivation	Water rinse	Water

TABLE II-2 (continued)

Tank No.	Plating Process	Use	Contents
59	Zinc, chromating and stainless steel passivation	Water rinse	Water
60		Phosphate	Phosphoric and phosphorous acid solution
61		Water rinse	Water
62		Clean and strip	Alkali, concentrated caustic solution
62A	Zinc, chromating and stainless steel passivation	Hot air	
63	Phosphate and black oxide	Caustic electric	Sodium hydroxide, 5% solution
64		Water rinse	Water
65		Acid	Hydrochloric acid, concentrated
66		Water rinse	Water
67		Phosphate	Phosphoric acid
68		Phosphate	Phosphoric acid
69		Condition rinse	Chromic acid
70		Copper etch	Chromic and sulfuric acid
73		Water rinse	Water
74		Acid	Hydrochloric acid
75		Water rinse	Water
76	Phosphate and black oxide	Water rinse	Water

TABLE II-2 (continued)

Tank No.	Plating Process	Use	Contents
77	Phosphate and black oxide	Water rinse	Water
78		Caustic	Sodium hydroxide, 5% solution
79		Water rinse	Water
80		Hot air	
81		Utility and wax	
82		Water rinse	Water
83		Phosphate	Phosphoric acid, 3% solution
85		Water rinse	Water
86		Pickle aluminum	Chromic and sulfuric acid, highly concentrated
87		Water rinse	Water
88		Water rinse	Water
89		Alodine 1200	Sodium dichromate, nitrate fluoride salts
90		Water rinse	Water
91		Water rinse	Water
92		Water rinse	Water
93		Acid etch	Nitric acid, concentrated
94		Black oxide	Sodium nitrate and sodium hydroxide, highly caustic
95		Water rinse	Water
96	Phosphate and black oxide	Caustic	Sodium hydroxide, 5% solution

TABLE II-2 (continued)

Tank No.	Plating Process	Use	Contents
97	Skin strip and paint remover	Water rinse	Water
98		Pickle aluminum	Chromic and sulfuric acid, highly concentrated
99		Deoxidant	Sodium hydroxide zincated solution, highly concentrated
100		Water rinse	Water
101		Paint remover	Organic acid (formic), concentrated
102	Skin strip and paint remover	Water rinse	Water
103	Anodizing	Water rinse	Water
104		Black dye	Organic asphalt derivative
105		Water rinse	Water
106		Water rinse	Water
107		Cleaner	Alkali, caustic solution
108		Anodize	Sulfuric acid, 17% solution
109		Water rinse	Water
110		Green dye	Organic derivative
111		Red dye	Organic derivative
112		Black dye	Organic derivative
113		Water rinse	Water
114		Black dye	Organic derivative
115	Anodizing	Seal	Nickel acetate, mildly acid

TABLE II-2 (continued)

Tank No.	Plating Process	Use	Contents
116	Anodizing	Seal	Nickel acetate, mildly acid
117		Water rinse	Water
118		Water rinse	Water
119		Anodize	Sulfuric acid, 17% solution
120		Water rinse	Water
121		Cleaner	Alkaline, mildly caustic solution
122		Water rinse	Water
123		Seal	Mildly acid 5% solution
124		Water rinse	Water
125		Water rinse	Water
126		Cleaner	Alkaline, mildly caustic
127		Water rinse	Water
128		Cleaner	Alkaline, mildly caustic
134	Anodizing	Degreaser	Trichlor
135	Impregnating	Water rinse	Water
136		Cleaner	Alkali solution, caustic
137		Water rinse	Water
138		Cleaner	Alkali solution, caustic
139	Impregnating	Impregnation	Styrene

TABLE II-2 (continued)

Tank No.	Plating Process	Use	Contents
Floor 2			
AA205	Printed circuit boards	Plating	Selrex gold acid
A24771		Plating	Selrex gold acid
None		Plating	Copper sulphate
None		Plating	Copper sulphate
None	Printed circuit boards	Plating	Copper sulphate

TABLE II-3 . METAL TREATING OPERATIONS

Tank No.	Process	Use	Contents
Bldg 47-1			
1	Metal preparation	Tank	Acid
2	↓	Tank	Hot water
3	↓	Tank	Zinc
4	↓	Tank	Hot water
5	↓	Tank	Acid
6	↓	Tank	Hot water
7	↓	Tank	Acid
11	Metal preparation	Tank	Soap coating
1	Storage	Outside tank	Sulfuric acid
1	Heat treat	Salt pot	Salt
2	Heat treat	Salt pot	Salt
3	Heat treat	Salt pot	Salt
4	Heat treat	Salt pot	Salt
5	Heat treat	Tank	Oil
Bldg 48-1			
1	Metal preparation, Borreson unit	Tank	Oakite
2	↓	Tank	Hot water
3	↓	Tank	Sulfuric acid
4	↓	Tank	Sulfuric acid
5	Metal preparation, Borreson unit	Tank	Sulfuric acid

TABLE II-3 (continued)

Tank No.	Process	Use	Contents
Bldg 48-1			
6	Metal preparation, Borreson unit	Tank	Cold water
7		Tank	Hot water
8		Tank	Zinc phosphate
9		Tank	Cold water
10	Metal preparation, Borreson unit	Tank	Hot water
Bldg 55-1			
1	Metal preparation, Bonderite line	Neutralizer tank	Dioxylite
2		Water tank	Water
3		Bonderite tank	Bonderite
4		Water tank	Water
5		Acid tank	Phosphoric cleaner
6		Water tank	Water
7	Metal preparation, Bonderite line	Alkali tank	Alkali
Bldg 55-2			
F-642	Heat treat	Furnace	
F-643	Heat treat	Furnace	
F-654	Heat treat	Furnace	
F-655	Heat treat	Furnace	

TABLE II-3 (continued)

Tank No.	Process	Use	Contents
Bldg 55-2			
F-656	Heat treat	Furnace	
F-657	Heat treat	Furnace	
F-847	Heat treat	Furnace	
F-1005	Heat treat	Furnace	
Bldg 120			
1	Surface treating udylite production, anodizing system	Tank	Zincated solution, highly caustic
2		Tank	Cold Water
3		Tank	Caustic oakite #164 alkaline solution
4		Tank	Cold water
5		Tank	Chromic and sulfuric acid
6		Tank	Cold water
7		Tank	Sulfuric acid, 17% solution
8		Tank	Cold water
9		Tank	Cold water
10		Tank	Sodium dichromate, 5% solution
11		Tank	Organic derivative
12		Tank	Cold water
13	Surface treating udylite production, anodizing system	Tank	Nickel acetate, 5% solution

TABLE II-3 (continued)

Tank No.	Process	Use	Contents
Bldg 120			
14	Surface treating udylite production, anodizing system	Tank	Cold water
15	Surface treating udylite production, anodizing system	Tank	Hot water
16	Surface treating udylite production, anodizing system	Tank	Hot air
Exhaust	Surface treating udylite production, anodizing system	Exhaust system	Acid and alkali in same system, including air exhaust fans XM1, XM3, and XM12
None		Vapor degreasing unit, including exhaust system XM3A	Trichlorethylene is the medium
Bldg 216-1			
F-573	Heat treat	Furnace	
F-620		Furnace	
F-625		Furnace	
F-626		Furnace	
F-627		Furnace	
F-628		Furnace	
F-814		Furnace	
F1043	Heat treat	Furnace	

TABLE II-3 (continued)

Tank No.	Process	Use	Contents
Bldg 216-1			
F1088	Heat treat	Furnace	
A30089	↓	Furnace	
F-564	↓	Electric furnace	
F-664	↓	Nitriding pot	
F-963	↓	Lead pot	Lead
F998	↓	Lead pot	Lead
F1029	↓	Nitriding	
X121092	↓	Salt pot	Salt
X121091	Heat treat	Salt pot	Salt
Bldg 217-1			
1	Udylite production, cyanide copper barrel plating system	Tank	Cleaner oakite 90M, 6 oz/gal
2	↓	Tank	Hot water rinse
3	↓	Tank	Cold water rinse
4	↓	Tank	Hydrochloric acid pickle, 50% solution
5	↓	Tank	Cold water rinse
6	↓	Tank	Cold water rinse
7	Udylite production, cyanide copper barrel plating system	Tank	Cyanide copper solution

TABLE II-3 (continued)

Tank No.	Process	Use	Contents
Bldg 217-1			
8	Udylite production, cyanide copper barrel plating system	Tank	Cyanide copper solution
9	Udylite production, cyanide copper barrel plating system	Tank	Cold water rinse
10	Udylite production, cyanide copper barrel plating system	Tank	Hot water rinse
11	Udylite production, cyanide copper barrel plating system	Tank	Hot air dryer

The materials that remain wide-spread are the paints, lacquers, enamels, thinners, adhesives, "potting" compounds, and similar flammable materials in substantial quantities stored in sheds and storage cabinets throughout the post (see trip report field notes, Appendix D).

Over the last several years, USAEHA has been checking FFA for the physiological aspects of nitroglycerin. Sites involved in these studies were buildings 209 (third floor), 214 (third floor), 222, 224, 229, 240, 241, 242, 243, 244, 245, 246, 247, 248, 316, and 440.

B. Laboratory Research, Development, and Testing

The Pitman-Dunn Laboratory (named for the founders) was a premier research and development laboratory involved in a myriad of research projects (e.g., propellants, metallurgy, spectroscope, chemical, ballistic, electronic, etc.). The metallurgical activities were centered in building 149. Building 64 has the spectographic laboratories and the heat treatment area in the basement. The Materials Research and Analytical Laboratories utilize the first floor. The second floor is used for chemical research. This building, particularly the second floor, can be considered an area of extensive chemical contamination.

During the consolidation operations, a suite of rooms in the southwest end of the second floor was used as the assembly point. Approximately 4,000 organic compounds and a similar number of inorganics were processed. For safety reasons propellant explosives and pyrotechnic materials were demilitarized when possible or transferred to a storage magazine. The mineral acids, ammonium hydroxide, and solvents were stored in sheds adjacent to building 65; and the collected carcinogens were packaged and stored along with the liquid mercury in building 61 (shed). The bulk of the chemicals, which include a substantial amount that originated within building 64, remains stored in the second floor suite. It was stated by Dr. Mikula that during the removal of some chemical hoods for transfer to Picatinny Arsenal, mercury contaminants were discovered. It is believed that this is indicative of the situation throughout the building. The research into high energy materials and the extensive utilization of heavy metals makes this site a unique decontamination project. Several other laboratories and test facilities that exist on post are:

1. Building 65, laser research.

2. Building 68, propellant and pyrotechnic test.

3. Buildings 201/202, fire control systems development.

4. Building 227, analytical and inspection laboratory.

5. Buildings 230/231, ordnance test and evaluation.

6. Buildings 247/248, research and development operation and test.

7. Buildings 301/304, CAD and PAD test area.

8. Building 305, fuze environmental testing.

9. Building 313, radiological and chemical laboratory.

Buildings 65 and 201/202 chemical contamination appears to be minor. Building 312 was the subject of a decontamination exercise in 1976. The remaining laboratories have their own esoteric situation related to the materials involved. However, they do not involve the diversity of materials encountered in building 64.

C. Field Test Ranges

1. Indoor Ranges

A series of test ranges exist in buildings 512 and 150.

2. Outdoor Ranges

A range existed from building 65, parallel to Dearborn Street, with the target butt located in the open area near the sea wall. The butt has been removed.

Test ranges were available at Fort Dix for FFA use.

Historically (circa 1900) two ranges existed, situated near the then unacquired Henning Tract. The longer, 500 yard range extended from what is now the location of building 57 toward the river wall, the site of a former draw bridge. The 100 yard range extended in an east-west direction in the general vicinity of what is now building 301. See Figure II-2.

The Arsenal facilities decontamination data sheets list building 316 as a research ballistic range.

D. Potential Burial Sites/UXO Sites

Although there are presently no active burial sites at FFA, information indicates that explosive ordnance was formerly buried within the boundary of the Arsenal. The following sites were identified during the interviews and collaborated by more than one person:

1. Historical Ordnance

During the early fifties Civil War ordnance rounds were found when digging in the area near one of the post entrances during construction of

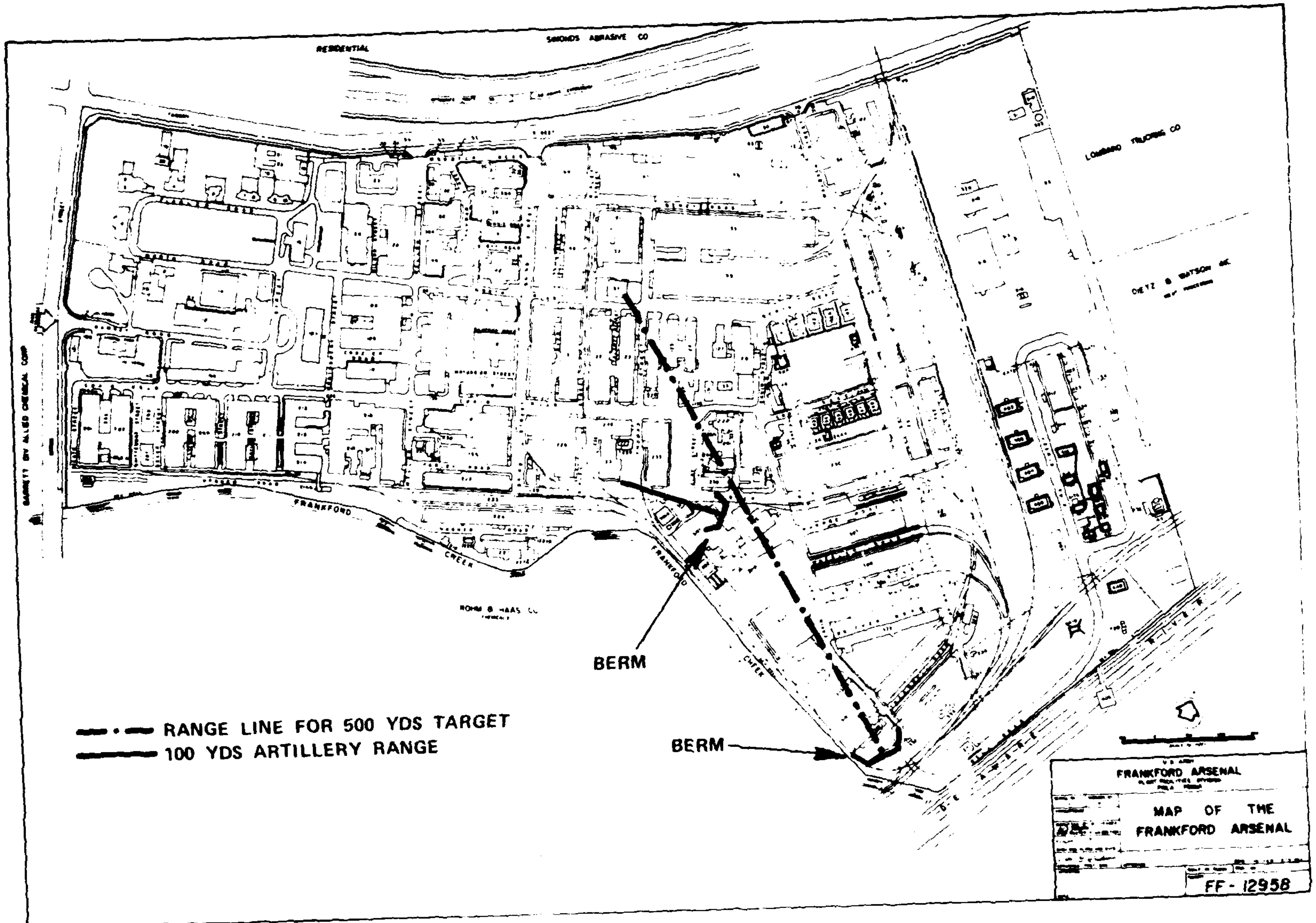


Figure II-2. FORMER TEST RANGES, (CIRCA 1900).

the fence and gates. Actual numbers and types of rounds recovered were not available at the Public Information Office; however, indications are that the rounds were not inert. Some confusion exists as to the exact site; Baird Street gate was mentioned in some of the interviews; however, Mr. Sheridan of the Corps of Engineers (COE) stated that the Walbach Street gate is the actual site. He also stated that no attempt was made to look for or recover any additional buried ordnance.

2. Catapult Construction Adjacent to Building 316

During construction of the catapult (building 319) adjacent to building 316, ordnance rounds from World War I were found when the foundations were dug. The ordnance (live artillery rounds) was found at two separate locations (corresponding to the general areas of the former outdoor ranges): under what is now an asphalt parking lot (northeast of building 316) and the southeast corner of building 316 where the catapult structure now stands. Building 316 was used from World War I until recently for ballistic research tests of artillery ammunition.

3. Caves

North of Craig Road and south of the 140 series of buildings was an area known as the "Caves." The area was formerly a series of underground storage caverns for Fitler Area explosive components (e.g., PETN and lead styphnate). The materials were removed and the site converted to a parking lot, circa 1970. Mr. Sheridan stated that all explosive materials were removed prior to the conversion; however, no check for residual contamination was made. Some Arsenal personnel interviewed held the opinion that ordnance was also stored at this site. However, no records were found as to quantity and type in support of this opinion.

4. Pier 409 on the Delaware River

Pier 409 on the Delaware River was used to load barges and ships with ammunition prior to World War II. Personnel interviewed stated that "all types" of ordnance used to be dumped into the Delaware River off the pier. It was "an easy way to get rid of stuff."

5. Frankford Creek

Considerable small arms ammunition was apparently thrown into the creek by FFA personnel. Those interviewed talked of throwing bullets at birds on the fence and the bullets landing in the creek. They talked in terms of "thousands of rounds." Frankford Creek also, in the past, had a dock where barges were loaded with ammunition for shipment.

6. Delaware River

During testing at the old outdoor range (parallel to Dearborn Street), many projectiles were reported to have missed the berm backstop and impacted into the Delaware River with some of the rounds landing across the river in New Jersey. Farmers would bring the projectiles back and file a complaint; however, the only reported fatality was one cow. No data is available on type/quantity of UXO in the river. Several reported that they had heard of a barge loaded with ammunition sinking in the Delaware River; however, the reported date of this incident varied from the Civil War to World War I. It was noted that the topographic map of the area places an asterisk in the Delaware River north of FFA and labels the asterisk "Frankford Arsenal." There was some speculation that the asterisk might mark the location of the sunken barge. However, during a review of the historical files now stored at the Rock Island Arsenal Historical Office, the probable source of the rumor was found. According to the contemporary arsenal military storekeeper, A. L. Roumfort, in a letter to the DuPonts, the sloop "Fame" ran aground on the flats near the Frankford Creek mouth. The date was 13 March 1841 and the cargo was 60 pieces of saltpeter (approximately 2,500 gallon volume).

E. Storage of Toxic/Hazardous/Radioactive Materials

As previously stated, ordnance material is in storage in the 400 Area magazines for eventual transfer to Letterkenny Army Depot for disposal. It should be noted that during the laboratory chemical consolidation operation, several apparently live rounds of ammunition were found throughout the post, kept perhaps as "momentos." These rounds were given to the Safety Office for disposition.

The Arsenal has a current inventory of 5,393 kilograms of depleted uranium (see Table II-4). The depleted uranium was utilized in various projects such as the Bushmaster, GAU-8, and the Alpha projectile. The storage areas used were buildings 149, 15, 227B (present major storage sites), 307, 312, and Transportainers 28 and 126 in the same area, the former building 507 (no longer exists), and 123.

Major processing and fabrication using depleted uranium were conducted in buildings 149, 150, 210 (third floor), 513, 45, 55, and 58 (balcony). The wastes from these operations were stored in drums with oil covering and disposed of as radioactive waste.

The test munitions were fired in building 316 (Range C) and building 521 (Range 16). No records were found regarding the use of the building 150 range although there were rumors to this effect.

Laboratories involved were building 64 (second floor) and building 312. Although subject to decontamination operations in 1976, the ventilation ducts and sewer drains are still suspect.

TABLE II-4. FFA PHYSICAL INVENTORY
URANIUM D-38
DECEMBER 1976

Bldg No.	Description	Metal Weight (Kg)	Net U Weight (Kg)	Subtotals	
227B	8.5% Mo				
	3 boxes 2½" diameter ingots	1,733.2	1,585.9		
	2½" diameter x 48" long rod	36.0	32.9		
	6 cans various items	161.5	147.8		
	1 box liner blanks	17.6	16.1		
	Rods, various lengths	90.7	83.0	2,039.0	1,865.7
	Unalloyed				
	2 boxes sliced derbies	765.5	765.5		
	Rods, various lengths	2.9	2.9	768.4	768.4
	2½ Zr + 2½ Cb + 2½ Mo + ½ Ti				
	1 box 105mm cores (12 pieces)	23.4	21.5	23.4	21.5
			Bldg 227B Total	2,830.8	2,655.6
150	Unalloyed				
	2 cartons 20 gr spheres	14.8	14.8		
	Display items	1.6	1.6		
	Plate, 30" x 6" x 3/8"	22.2	22.2		
	Plates, 6" x 6" x 1"	67.0	67.0		
	Plates, 6" x 6" x ½"	27.9	27.9		
	Plates, 6" x 6" x 2"	89.7	89.7		
	Plates, 6" x 18" x .080"	53.0	53.0		
	Plates, 8" x 8" x 1/16"	13.0	13.0		
	Plate and cone	1.8	1.8		
	U-steel rods	4.0	4.0		
	Pie cut ingot	409.8	409.8	704.8	704.8

TABLE II-4 (continued)

Bldg No.	Description	Metal Weight (Kg)	Net U Weight (Kg)	Subtotals	
150	8.5% Mo				
	Can 15mm cores	186.5	116.6		
	Can rod ends	9.8	9.0		
	Can rod ends	24.3	22.2		
	Cartons 1-7 gr spheres	1.6	1.5		
	Cartons 0.323" spheres	7.0	6.4		
	Cartons 0.405" spheres	5.1	4.8		
	Cartons 0.552" spheres	1.6	1.5		
	Cartons cubes	6.2	5.7		
	Ingot ends	6.2	5.7		
	Cores, 20mm	5.5	5.0		
	Rods, square	19.6	17.9		
	Display items	16.7	15.3		
	Box cubes (400 pieces)	12.5	11.4		
	Cases, 105mm (18 pieces)	47.0	43.0	349.6	320.0
	2½ + 2½ + 2½ + ½				
	Rods 2½" diameter	23.9	22.0		
	Rods 3/4" diameter	50.2	46.2		
	Riser heads	10.7	9.8		
	Cores	12.5	11.5	97.3	89.5
			Bldg 150 Total	1,151.7	1,114.3
149	Unalloyed				
	Drum	123.5	123.5		
	Rods, cores, spheres (Katlin)	16.3	16.3	139.8	139.8
	8.5% Mo				
	Drum	68.9	63.0		
	Box	17.6	16.1		
	Drum, 15mm cores	20.7	18.9		
	Rods, cores, spheres (Katlin)	22.6	20.7	129.8	118.7

TABLE II-4 (continued)

Bldg No.	Description	Metal Weight (Kg)	Net U Weight (Kg)	Subtotals	
149	8.5% Mo + 0.25% Si				
	2 boxes	26.6	24.3	26.6	24.3
	8.5% Mo + 0.50% Si				
	Box	16.2	14.7	16.2	14.7
	1½ Zr + 1½ Cb + 1½ Mo + ½ Ti				
	2 boxes	22.6	21.5		
	Rods, cores, spheres (Katlin)	22.8	21.7	45.4	43.2
	1.25% Ti				
	Box	7.7	7.6		
	Rods, copperclad	34.1	33.7		
	Rods (Katlin)	0.3	0.3	42.1	41.6
	2.0% Mo				
	Rods, cores, spheres (Katlin)	19.1	18.7	19.1	18.7
	4.0% Alloy				
	Rods	32.8	31.4	32.8	31.4
	0.75% Ti				
	Rods, 3" x 0.3"	6.5	6.2		
	Penetrators, tensile bars, ends	479.9	475.7	486.4	481.9
	Quad Alloy (0.75 Mo - 0.75 Zr - 0.75 Nb - 0.50 Ti)				
	Penetrators, tensile bars, ends	731.0	708.3	731.0	708.3
			Bldg 149 Total	1,669.2	1,622.6

TABLE II-4 (continued)

Bldg No.	Description	Metal Weight (Kg)	Net U Weight (Kg)	Subtotals
	Alloy Totals			
	Unalloyed	1,613.0	1,613.0	
	8.5% Mo	2,518.4	2,304.4	
	2½ Zr + 2½ Cb + 2½ Mo + ½ Ti	120.7	111.0	
	1½ Zr + 1½ Cb + 1½ Mo + ½ Ti	45.4	43.2	
	2.0% Mo	19.1	18.7	
	1.25% Ti	42.1	41.6	
	8.5% Mo + 0.50% Si	16.2	14.7	
	8.5% Mo + 0.25% Si	26.6	24.3	
	4.0% Alloy	32.8	31.4	
	0.75% Ti Alloy	486.4	481.9	
	Quad Alloy (97.25%)	731.0	708.3	
	Total	5,651.7	5,392.5	

Plus the following rounds of ammunition:

Bldg 519
100 rounds 20mm armor-piercing DU Flechette penetrators (Tricap)
100 rounds caliber 50 Flechette

Bldg 223
400 rounds 7.62mm DU cartridges

Other radioactive materials used on post related to the fire control system self-luminous devices, and involved buildings 201/202 and 108 (third and fourth floors). The primary radioisotope used was tritium (4^3) gas although other isotopes (e.g., Pm^{147} and Kr^{85}, etc.) were used. Storage areas for the tritium were the basement of building 108 and building 116 (which was also the packaging and shipping point).

Radioisotopes were also involved in propellant gages (Cs^{137} and Am^{241}). Five such devices were employed on post, at buildings 208 (first floor), 301A, 314 (second floor), and 521. The gage in building 521 is the only remaining unit and is scheduled for transfer to Fort Dix. The storage site for these gages was building 227B.

Miscellaneous sources of radioactive material such as carbon 14, microcurie levels of cobalt 60, nickel 63, strontium 90, etc., stored in buildings 227B, 127, and 57; radium Pyr-a-larm detectors (smoke) under the floor of the computer in building 109; polonium 210 sources used for anti-static purposes in building 150, currently stored in building 227B. Polonium anti-static brushes were also used in building 108. Tritium and radium were involved in luminous watches. An area of some concern is room 222, building 150; the watch shop in building 202 and the basement of building 519 were also involved.

Historically, the first storage site for radioactive material on post (radium in the 40's) was building 23.

During the records search, laboratory quantities of methane difluoro phosphine oxide, a chemical agent intermediate, was found in a glove box in room 215E of building 64. The material was subsequently removed from post by a Technical Escort Team for disposal. Also small cylinders (e.g., lecture bottle size) of toxic and reactives gases used in chemical synthesis were found in the chemical consolidation operations (e.g., phosgene, nickel carbonyl, azo methane, etc.). These gas cylinders were returned to the suppliers.

F. Support Activities

1. Water Supply

All water for FFA is supplied by the city of Philadelphia. The water is obtained from the Delaware River and is treated at the Torresdale Water Treatment Plant, located approximately two miles from FFA. Five metered lines from the Arsenal tap a distribution main that runs parallel to the northern boundary of FFA. The locations of these water meters are shown in Figure II-3. Water consumption for two consecutive three-month increments, between 17 September 1976 and 21 March 1977, was 80,066,250 gallons and 64,620,000 gallons respectively.

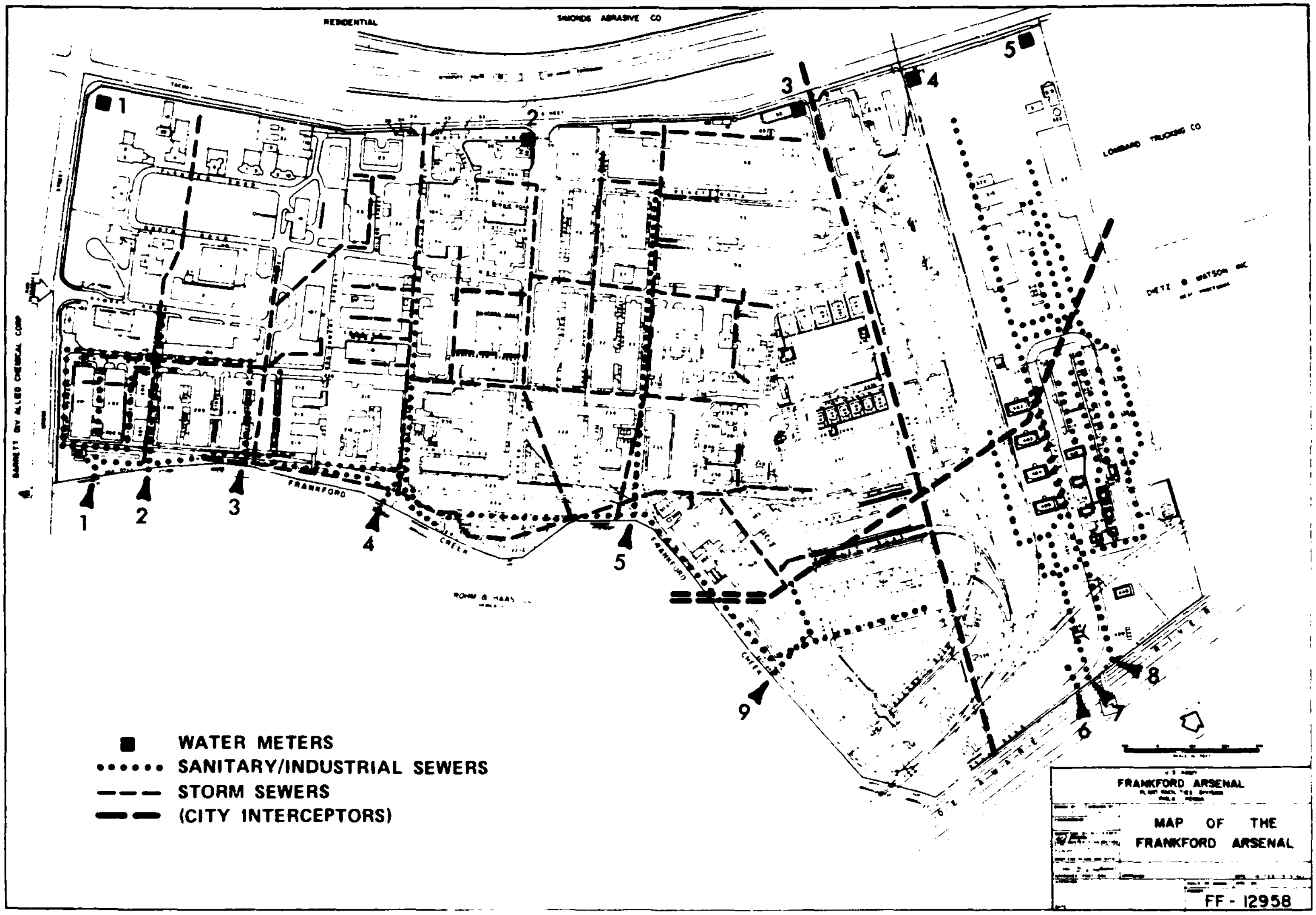


Figure II-3. LOCATIONS OF SANITARY-INDUSTRIAL SEWER SYSTEM OUTFALLS AND WATER METERS.

Water for fire hydrants is supplied by a 50,000 gallon elevated storage tank and a 250,000 gallon ground-level storage tank.

A water line to provide emergency water is still in place at FFA's river pier. In the event of an emergency, provisions had been made for a river tug to tie up at the pier and pump Delaware River water into the Arsenal's water system for production use.

2. Waste Disposal

FFA has a sanitary/industrial sewer system and a storm drainage system. A wastewater interceptor sewer owned and maintained by the Philadelphia Water Department passes under FFA property. All of the Arsenal's present sanitary and industrial wastewaters are discharged to this interceptor and treated at the Northeast Sewage Treatment Plant. The portion of Philadelphia served by the city's interceptor has combined sewers, and during periods of high rainfall, flow in the interceptor backs up to the point that FFA has experienced some flooding. The situation is relieved partly by the Arsenal's wastewater interceptor sewer bypass. As the city sewer interceptor backs up, wastewater from the city sewer enters FFA's wastewater sewer. If the level of wastewater gets high enough in the installation's interceptor, it is bypassed to the Frankford Creek Ditch through outfalls formerly used by FFA. See Figure II-3 for the location of the sanitary/industrial sewer system, the storm drainage system, and outfalls. Table II-5 is keyed to Figure II-3 and lists the outfalls, their dimensions, and status. FFA's storm drainage system is divided into three separate parts. The portion of FFA west of Walbach Street is served by a system which is effluent to the Frankford Creek Ditch. The area between Walbach Street and the Penn-Central railroad tracks is served by a system that empties into the Delaware River through the city's bypass sewer. The part of the Arsenal east of the Penn-Central railroad tracks is served by a system that empties directly into the Delaware River.

Numerous underground catch basins, sump pits, or neutralizing basins are located in and around the Arsenal's production buildings. These pits are both lined and unlined. There are three types of pits depending on what they were supposed to "catch" or neutralize: (1) oil, (2) acid, or (3) powder. The pits overflow into the sanitary/industrial sewer system and can be located on the installation's zone maps.

Solid waste on FFA can be divided into three categories: (1) garbage or rubbish, (2) bulky waste, and (3) solid metal waste. The garbage and rubbish is taken by Arsenal employees to the city of Philadelphia's incinerator for disposal. The bulky waste is picked up by a private contractor, Kaspar Brothers of Philadelphia, and hauled to a sanitary landfill in Cinnaminsin Township, New Jersey. The estimated monthly average volume of solid waste in 1977 for the first two categories of solid waste is 2,300 cubic yards (uncompacted). Solid metal waste consisting of metal turnings,

TABLE II-5. DIMENSIONS AND STATUS OF OUTFALLS

Outfalls	Dimensions	Height to Overflow	Status
Storm Drainage			
1	12 in diameter	N/A	Abandoned and plugged
2	24 in diameter	N/A	Abandoned and plugged
3	18 in diameter	10 ft	Live
4	30 in diameter	7 ft 1.5 in	Live (relief)
5	36 in diameter (2 lines)	15.1 ft	Live
6	6 in diameter	2 ft	Live
7	2 ft x 3 ft brick "Fitler" sewer	7 ft	Live
8	30 in diameter	8.3 ft	Live
Sanitary Industrial Sewer System			
9	10 in diameter backwater valve	7 ft	Live

trimmings, and scrap metal is taken to the property disposal area for salvage and eventual removal by a contractor. Table II-6 gives the solid metal waste disposed of from FFA between July 1969 and November 1969.

TABLE II-6. SOLID METAL WASTE DISPOSED OF AT FFA BETWEEN JULY 1969 AND NOVEMBER 1969

Solid Waste	Pounds
Steel turnings	503,250
Heavy steel	184,750
Light steel	240,030
Steel cutoff	75,100
Steel shells	37,600
Electronics scrap	7,300
Other scrap	78,200
Miscellaneous metals	7,950
Aluminum turnings	92,915
Other aluminum	37,550
Contaminated aluminum	5,750
Stainless steel	9,600
Manganese	9,000

G. Land Use Factors

1. Pesticide/Herbicide/Fertilizer Usage

Formal pesticide/herbicide use plans were established at FFA in 1966. Herbicide usage on the Arsenal is limited to control of all vegetation on gravel areas and railroads. Seventeen acres are treated once a year with Monuron at 20 pounds per acre to control poison ivy, spotted sage, dallas grass, and milkweed.

Five acres of lawn area are fertilized once a year early in the spring with a 5-10-5 (5 pounds of nitrogen, 10 pounds of phosphoric acid, and 5 pounds of potash) fertilizer at a rate of 1,000 pounds per acre. This fertilizer is applied to the administrative and family housing area (see Figure II-4).

2. Sanitary Landfills

One two-phase sanitary landfill was located on the eastern boundary along the Delaware River (see Figure II-5). It is estimated that the northern half was last used approximately 20 years ago (1957). The southern half, which is older, was last used 35 to 40 years ago (1937-1942). Building 440, located on the southern half, was built in 1945. Interviews indicated

that no contaminants were deposited in the landfill. It was a clean-fill type operation; only building and construction materials were placed in the landfill.

H. Geological Migration Potential Time Distance Relationships

Specific data was not available concerning vertical permeability of the soil or movement of groundwater at FFA. Philadelphia District Corps of Engineers personnel indicated an estimated vertical permeability at .2 inches per hour and groundwater movement of 20 to 100 feet per year with an average of 50 feet per year.

Vertical migration of contaminants can occur but the filtering capability of the subsurface is not known at this time. The potential existed for contamination migration from the unlined neutralization pits.

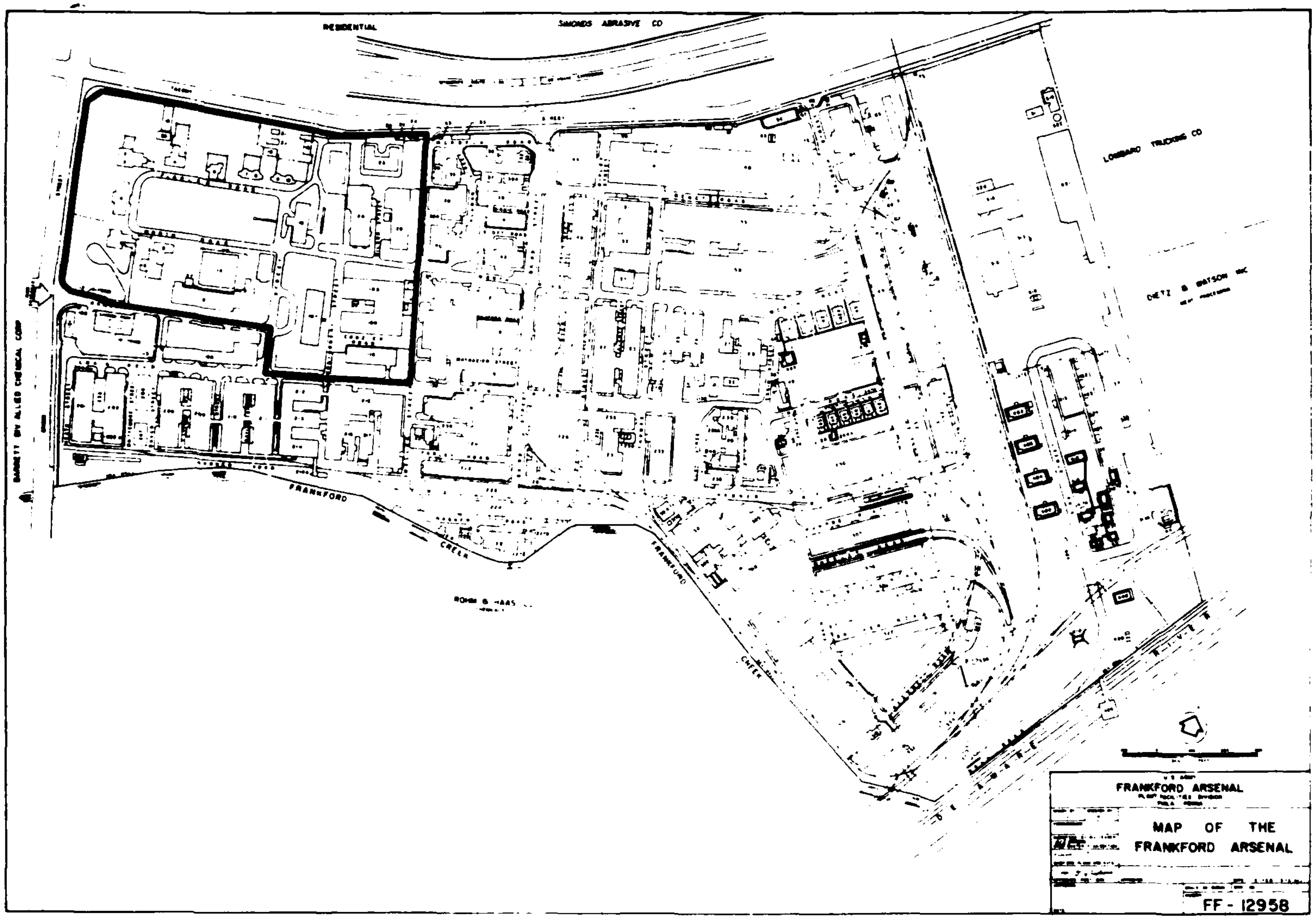


Figure II-4. LOCATION OF FERTILIZED AREAS.

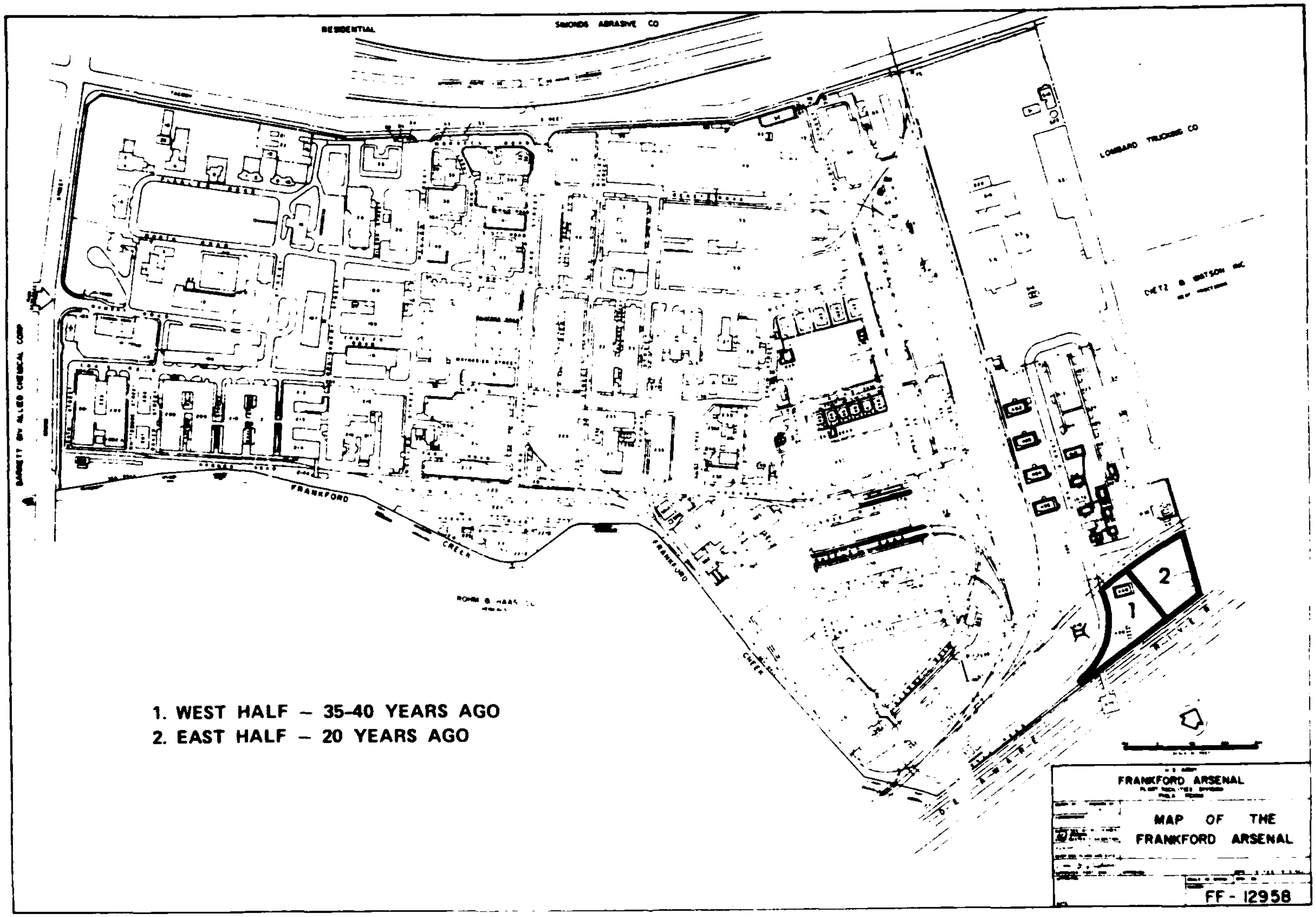


Figure II-5. LOCATION OF SANITARY LANDFILLS.

III. FINDINGS

A. Propellant and Pyrotechnic Wastes from Production Activities

The production areas of the Arsenal are contaminated or potentially contaminated with explosive, pyrotechnic, or propellant wastes resulting from the manufacture and loading of small arms ammunition, tracer ammunition, propellant and cartridge actuated devices, and lead styphnate.

B. Disposal Operations

There are no areas currently used as landfills for military or sanitary wastes. All such materials were removed by a contractor or by shipment to a military installation capable of disposing of explosive wastes (Letterkenny Army Depot). Evidence does exist of prior disposal, by burial, circa the Civil War period.

A small burning area, designated as building 439, was used for incinerating limited quantities of material. The ash was containerized and disposed of as contractor serviced scrap.

Quantities of ammunition are reported to be present in the adjacent Frankford Creek and Delaware River as a result of target overshoot and expedient disposal activities in the past.

C. Range Operations

Buildings 521 and 150 contain a series of indoor target ranges used for ammunition testing. Three outdoor target ranges once existed in the east-central area of the Arsenal. Two ranges have been superseded by building construction, and the target butt of the third has been removed.

Building 316 was the site of the cartridge actuated devices ballistic testing.

Of the above ranges, the activities at building 521 remain operational with its functions scheduled for transfer to Fort Dix, New Jersey.

Unexploded ordnance (UXO) is suspected to be present at several sites. Civil War material was found at the present site of the Walbach Gate, and World War I munitions were reported to be found during building construction in the vicinity of two former outdoor ranges. There are no records indicating disposal operations to remove the UXO from these sites.

D. Chemical, Biological, and Radiological Materials

Large quantities of commercial chemicals related to production and plating operations exist scattered throughout the installation. The most

notable of these sites is the plating shop, building 45, where the cyanide and acid baths remain.

Mercury contamination was also found; approximately one ton of the containerized liquid metal was found onsite. This find is attributed to post clean-up exercise, where large quantities of laboratory reagents were accumulated and consolidated in a holding area of the Pitman-Dunn Laboratory, building 64.

Large quantities of radiological materials remain in storage at the Arsenal, the major portion being 5,393 kilograms of depleted uranium stored in buildings 227B, 149, and 150.

E. Water Quality

Frankford Arsenal obtains its water from the Philadelphia water system and returns the waste water to the city's sanitary sewer system. Data available on the analysis of this waste stream gives no indication of contamination. It should be noted that the sanitary waste analysis does not include tests for explosive or propellant components (e.g., PETN).

F. Contaminant Migration

The area of concern is the Fitler or "400" Area, the former site of the lead styphnate production. The sewer lines are suspected of being contaminated. These lines terminate at the catch basin for the 400 Area on the bank of the Delaware River. The basin is in a state of disrepair.

It is believed that any subsurface contamination due to historical activities may be a potential problem.

IV. CONCLUSIONS

Areas of potential explosive/pyrotechnic, radiological, chemical, and unexploded ordnance contamination were identified and, in addition, other areas of potential contamination were documented.

V. RECOMMENDATIONS

It is recommended that the findings of the Records Research Team be reviewed by personnel responsible for the decontamination program at FFA and, where applicable, be incorporated into the program.

BIBLIOGRAPHY

1. AEHA Entomological Survey Number 44-007-73, dated September 1972.

2. AEHA General Sanitary Engineering Survey Number 24-016-70, dated November 1969.

3. AEHA Water Quality Engineering Special Study Number 24-029-73/75, Industrial Wastewater, dated August 1973.

4. AEHA Water Quality Monitoring Consultation Number 24-008-74, dated August 1973.

5. AMC General Order 252, dated October 1970.

6. AMC Historical Pamphlet, "Our First 150 Years, US Army Munitions Command, Frankford Arsenal," dated 1966.

7. AMC Installation and Activity Brochure, AMC IS-102 (RI), dated 31 March 1975.

8. Army Regulation 420-74, "Natural Resources - Land, Forest, and Wildlife Management."

9. Army Regulation 420-76, "Pest Control Services," November 1971.

10. Draft Project Plan, Installation Restoration of Frankford Arsenal, Pennsylvania, dated September 1977.

11. Frankford Arsenal Brochure, "Fabrications Capabilities."

12. Frankford Arsenal Environmental Impact Assessment, dated 23 September 1975.

13. Frankford Arsenal Personal Analysis, Annual Unit Historical Report, FY 76.

14. Frankford Arsenal Publication, "Through the Years at Frankford Arsenal, 1816-1971."

15. Letter: Installation Natural Resources Report - FA, dated July 1969.

16. Letter: Special Visit on Natural Resources Management - FA - AMC Installation and Special Services Agency, dated August 1974.

17. Pennsylvania Geological Survey Bulletin W-13, "Groundwater Resources of the Coastal Plain Area of Southeastern Pennsylvania," 1961.

18. Soil Survey of Bucks and Philadelphia Counties, Pennslyvania US Department of Agriculture Soil Conservation Service, July 1975.

19. Unsigned Narrative History Circa 1909, "The Frankford Arsenal," on file in the Records Research Office.

APPENDIX A

LIST OF KEY PERSONNEL INTERVIEWED

LIST OF KEY PERSONNEL INTERVIEWED

Name	Position
Bird, Warren	Chief, Components Engineering
Blickley, John	Chief, Production Division
Boldine, Lou	Physicist
Bomberger, Alfred	Foreman
Bravo, John	Chemical Engineer
Bruno, Al	Munition Mechanics Foreman
Bushey, B. W.	Director, MTD
Corcoron, Edmond	Public Affairs Officer
Cortese, Eugene	Counsel
Costello, Robert	Electro Plate Foreman
Dignam, John	Functional Equipment Co-on Division
Donahue, J. A.	Chief, S. C. Ballistic Evaluation Branch
Donnard, Reed	Supervisor, Mechanical Engineering (retired)
Farris, Frank	Procurement Office
Fidell, Francis	Safety Office
Gower, Edward	General Foreman
Kirshner, Howard	Chief, A/C Propellant and Pyrotechnic Branch
Lawrence, Stan	Chief, System Engineering Office (retired)
Makula, J. J.	Chief, Chemical Department Pitman-Dunn Laboratories

Name	Position
Manning, H. P.	Director, Munitions (retired)
Mattis, Irwin	WS Assistant Foreman
Morena, Joseph	Legal Office
Nixon, Simon L.	Assistant Metal Work Foreman
Penn, Harry	Small Caliber Production
Pikeeman, John	Engineer Technology Mechanic
Quinlan, Joseph	Research Chemist
Rempfer, Edward	Chemical Engineer
Schlack, Allen	Chemical Engineer
Sokolowski, Hank	Acting Director, Technical Support
Stanley, Linda	Research Assistant
Steel, Charles	Engineer
Taylor, Maurice	Chief, Standardization Office (Ordnance Engineer)
Tees, Elwood	General Foreman, Munitions
Valley, Frank	Closure Officer, FFA
Worsley, Thurman	Real Property Office

APPENDIX B

PHOTOGRAPHS

The Frankford Arsenal, Frankford, Philadelphia, Pa.

Figure 1. Historical photo of cannon and shells taken after the Civil War.

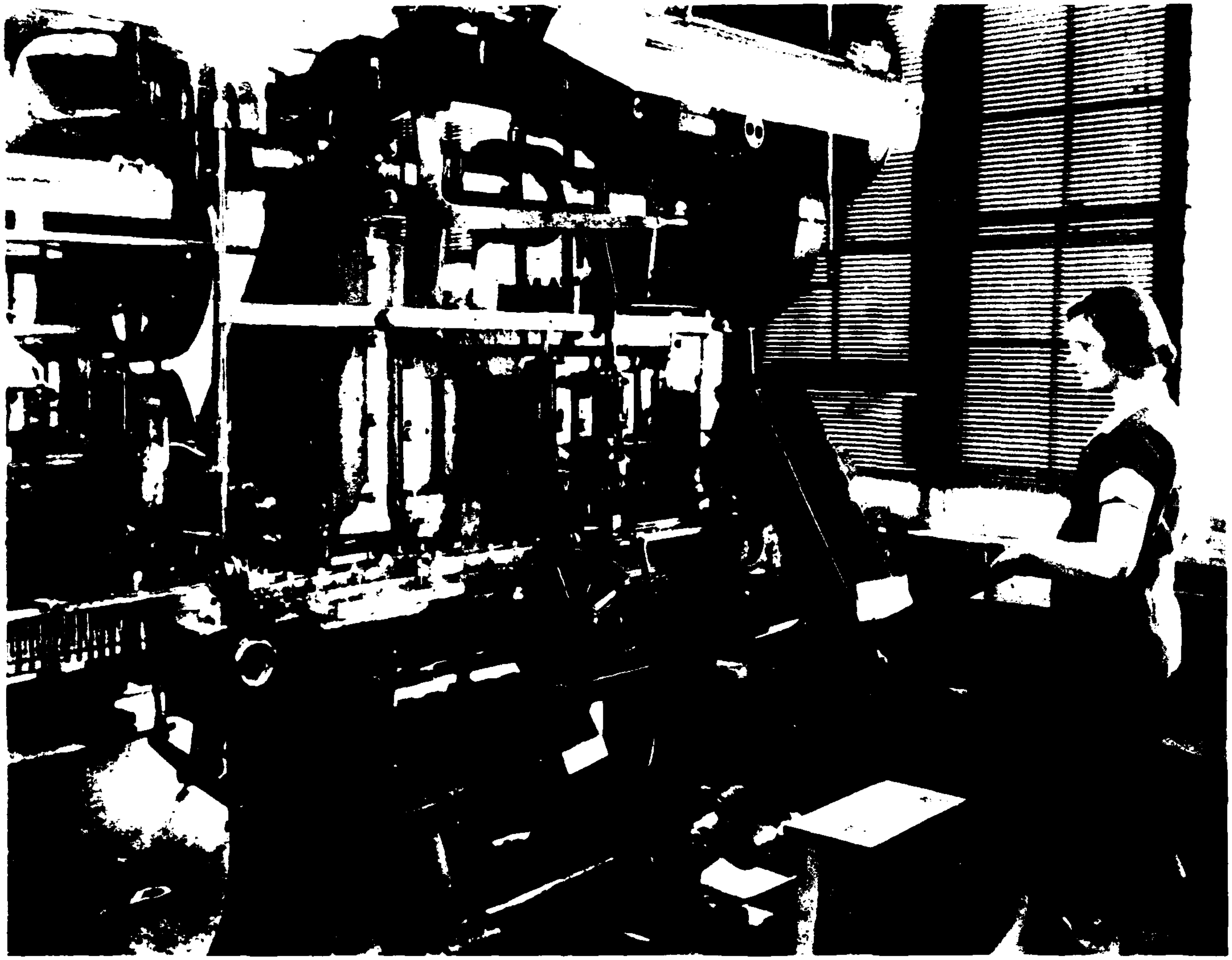


Figure 2. Loading small arms ammunition at FFA, 1972 Archives photo.

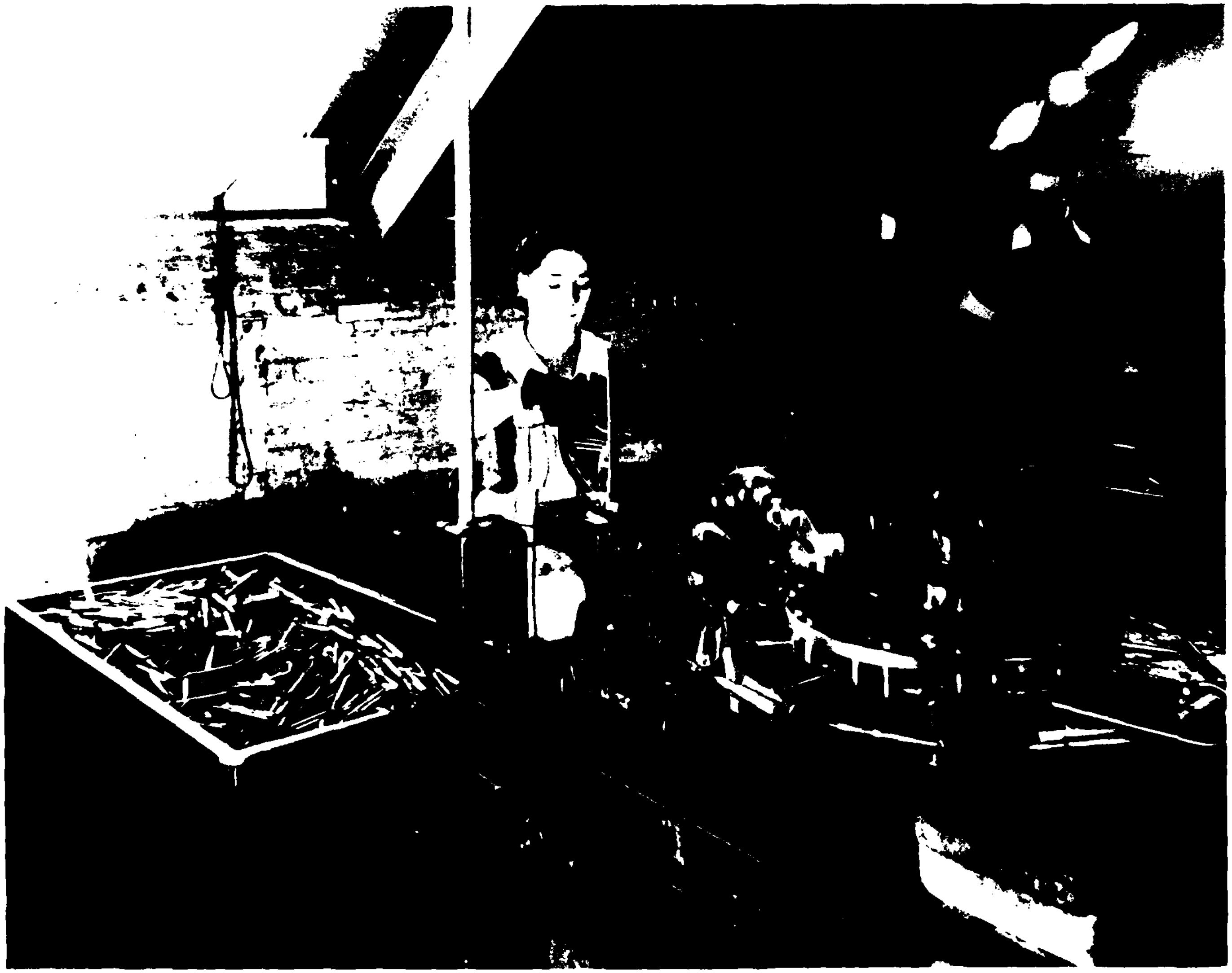


Figure 3. Loading small arms ammunition at FFA, 1972 Archives photo.

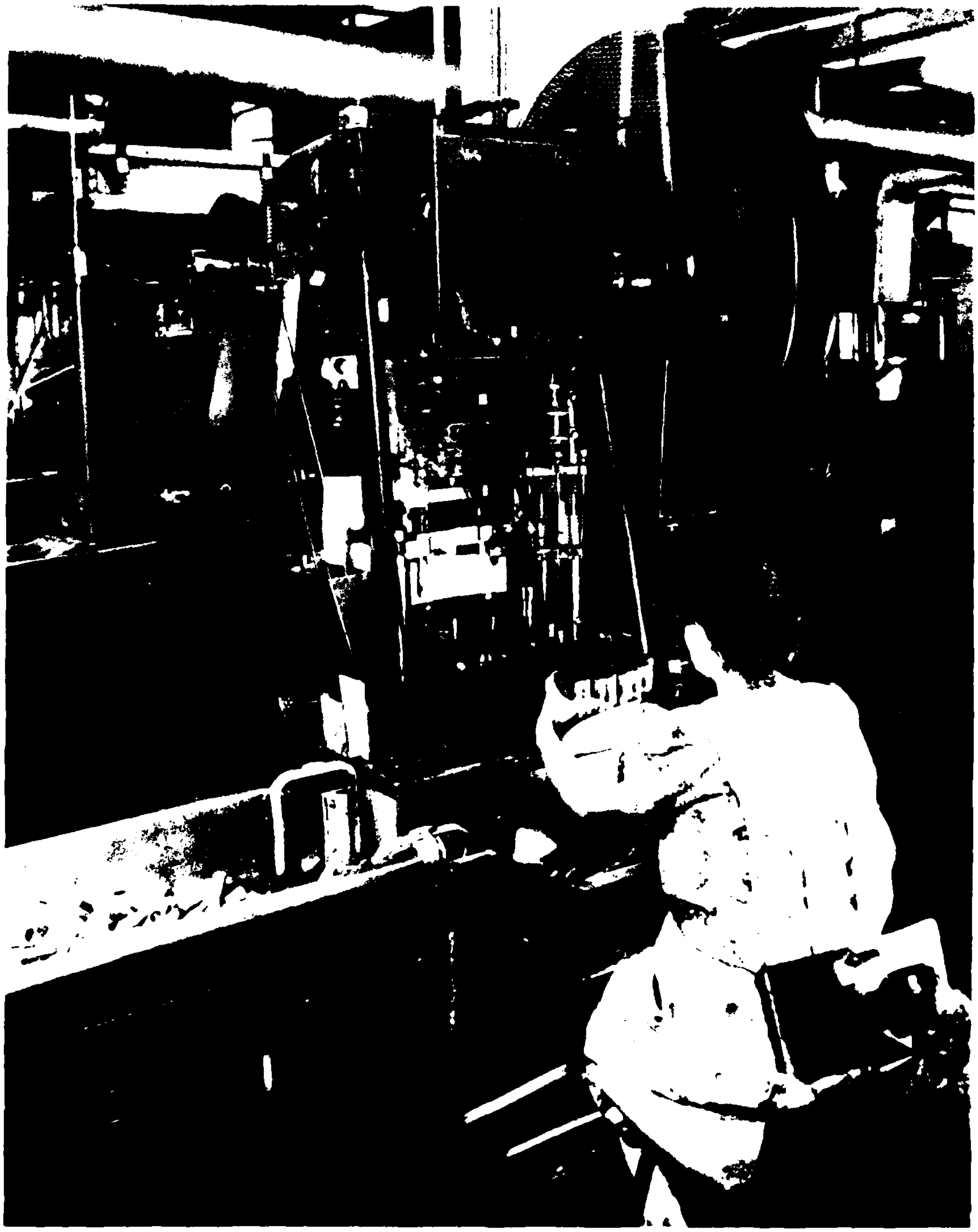


Figure 4. Loading small arms ammunition at FFA, 1972 Archives photo.

Figure 5. View showing 500 yard backstop of small arms firing range adjacent to Frankford Creek, 5 February 1947.

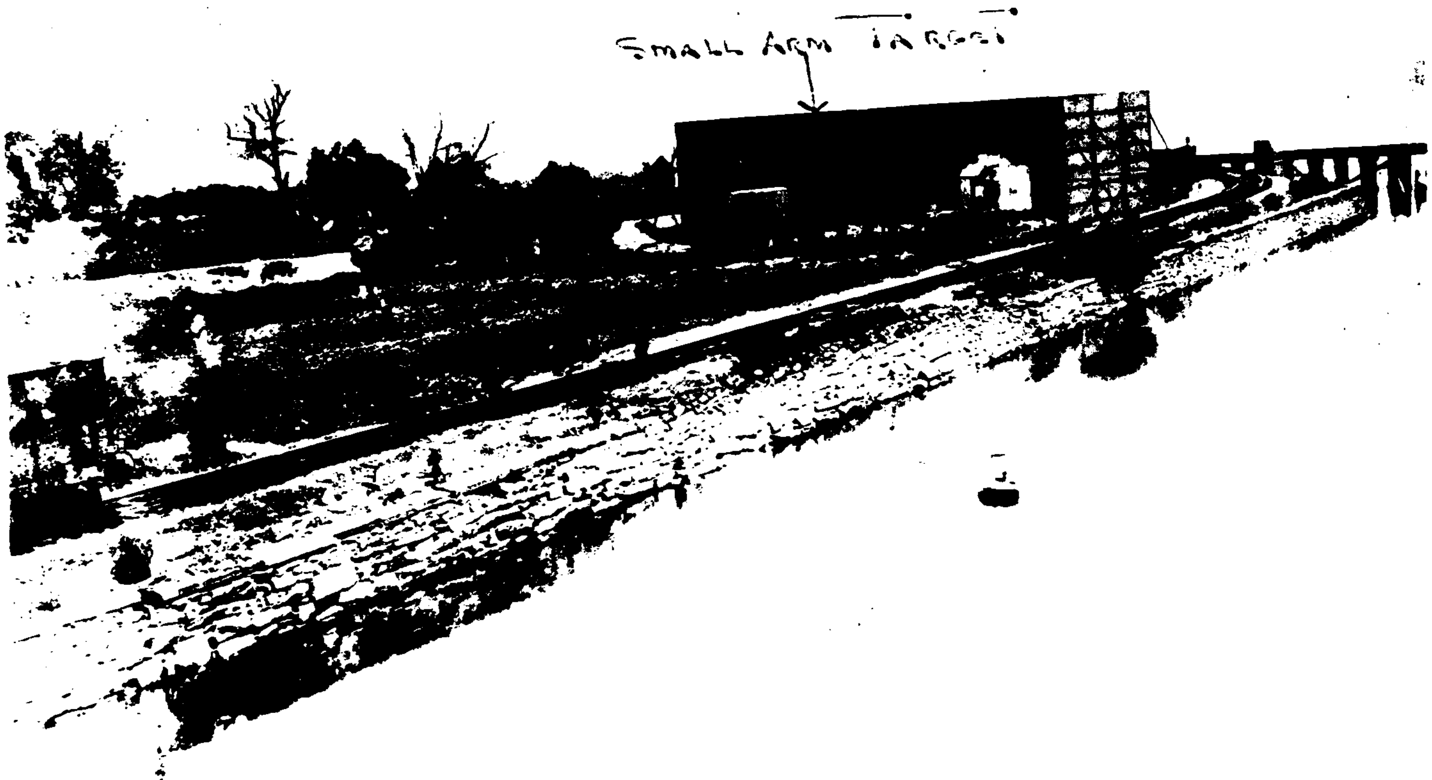


Figure 6. Small arms test range adjacent to Frankford Creek, 1947 Archives photo.

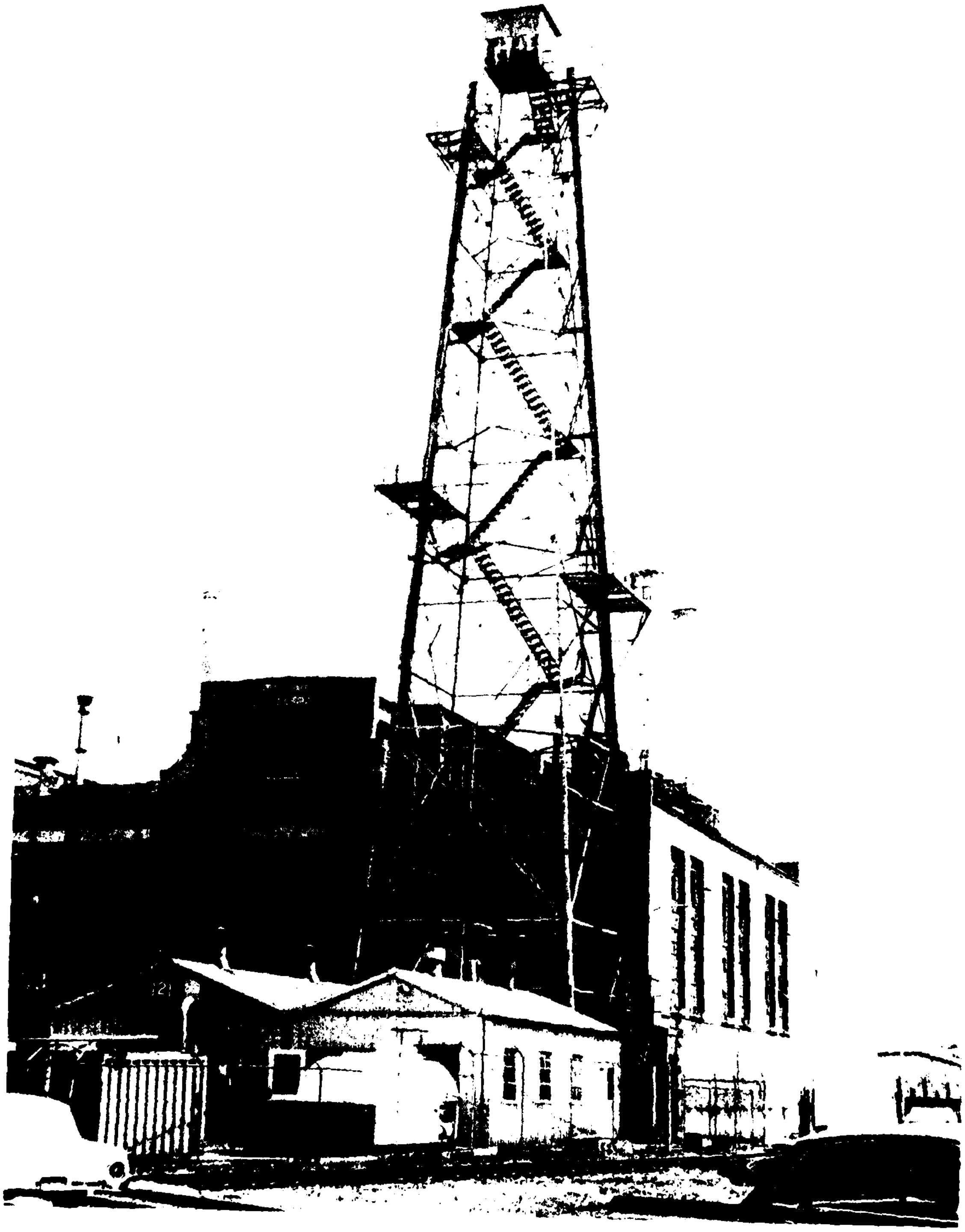


Figure 7. Drop tower adjacent to Bldg 301. Live WWI ammunition was discovered when digging foundation of tower.

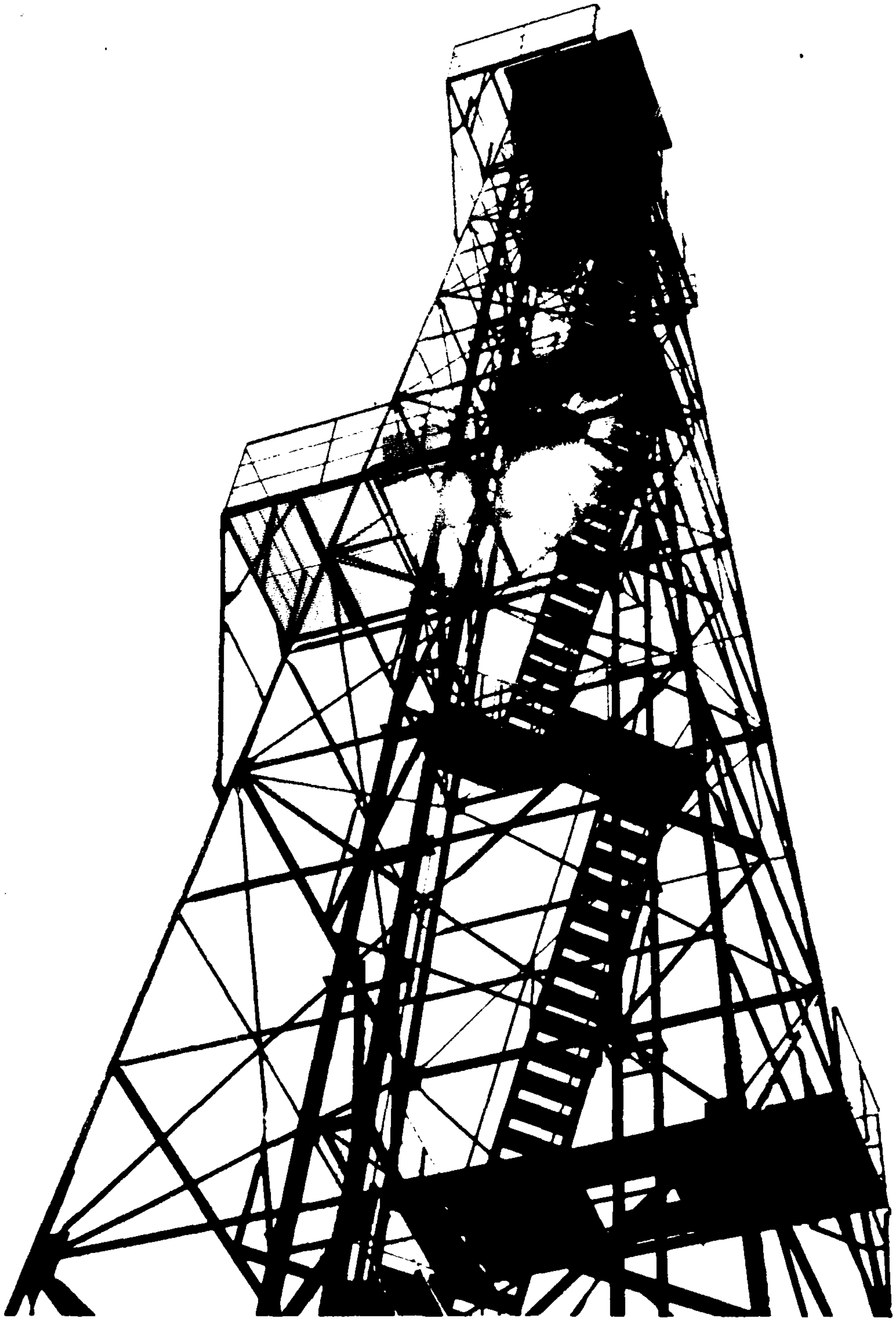
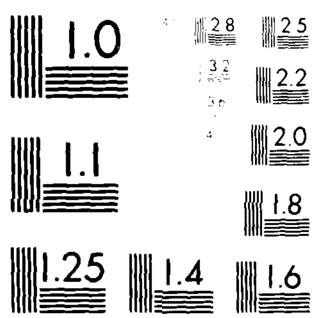


Figure 8. Drop tower.

AD-A110 393 ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY ABERDEEN P--ETC F/G 13/2
INSTALLATION ASSESSMENT OF FRANKFORD ARSENAL.(U)
OCT 77
UNCLASSIFIED DRXTH-ES-IA-77115 NL

2 OF 2
AD A
110 393

END
DATE
FILMED
02-82
DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU [illegible]

Figure 9a. Views showing portion of seawall along Delaware River.

Figure 9b. Steel grating is outfall for Fitler Sewer.

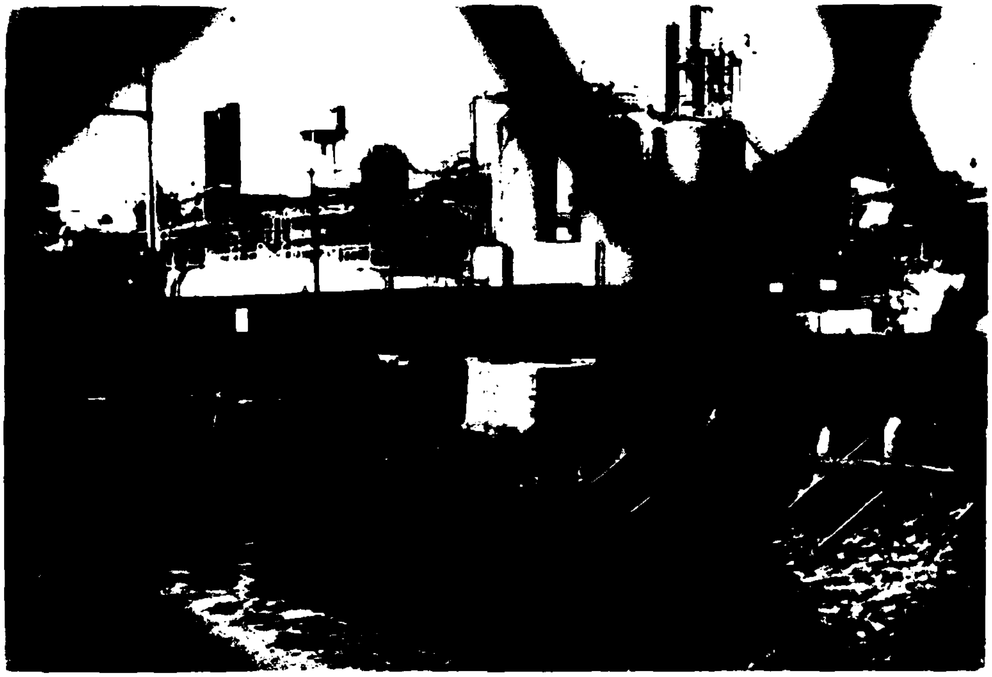


Figure 10a. Mouth of Frankford Creek Ditch.

Figure 10b. Frankford Creek Ditch, Bldg. 224 and 223 in background.

Figure 11a. Groundwater running from crack in seawall.

Figure 11b. Same as 11a., different angle.

Figure 12a. Site of former landfill. Concrete slab in background is helicopter pad.

Figure 12b. Site of former landfill. Bldg 440 in background.

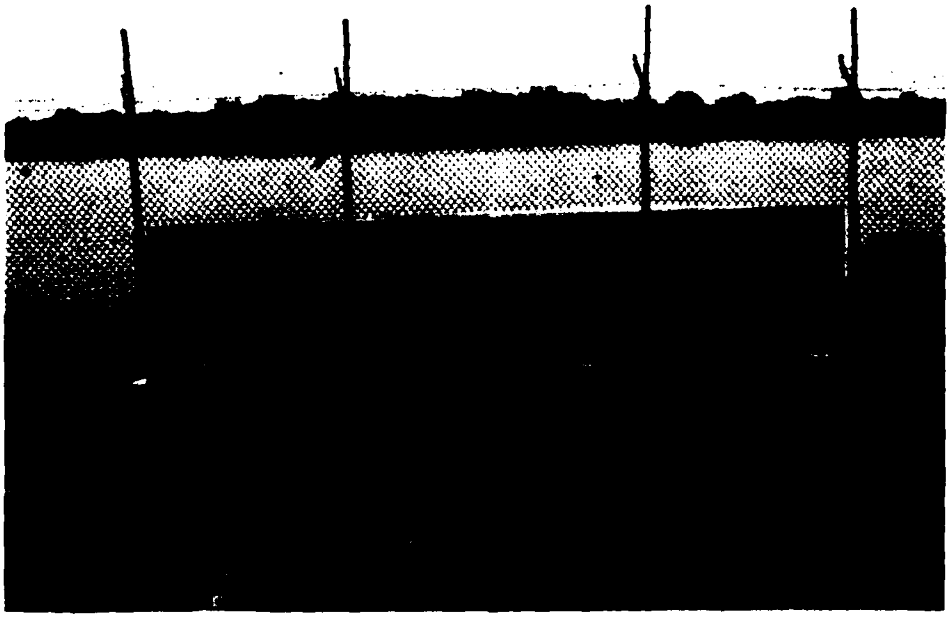


Figure 13a. "409" sump.

Figure 13b. Parade ground, Bldg 14 in background.

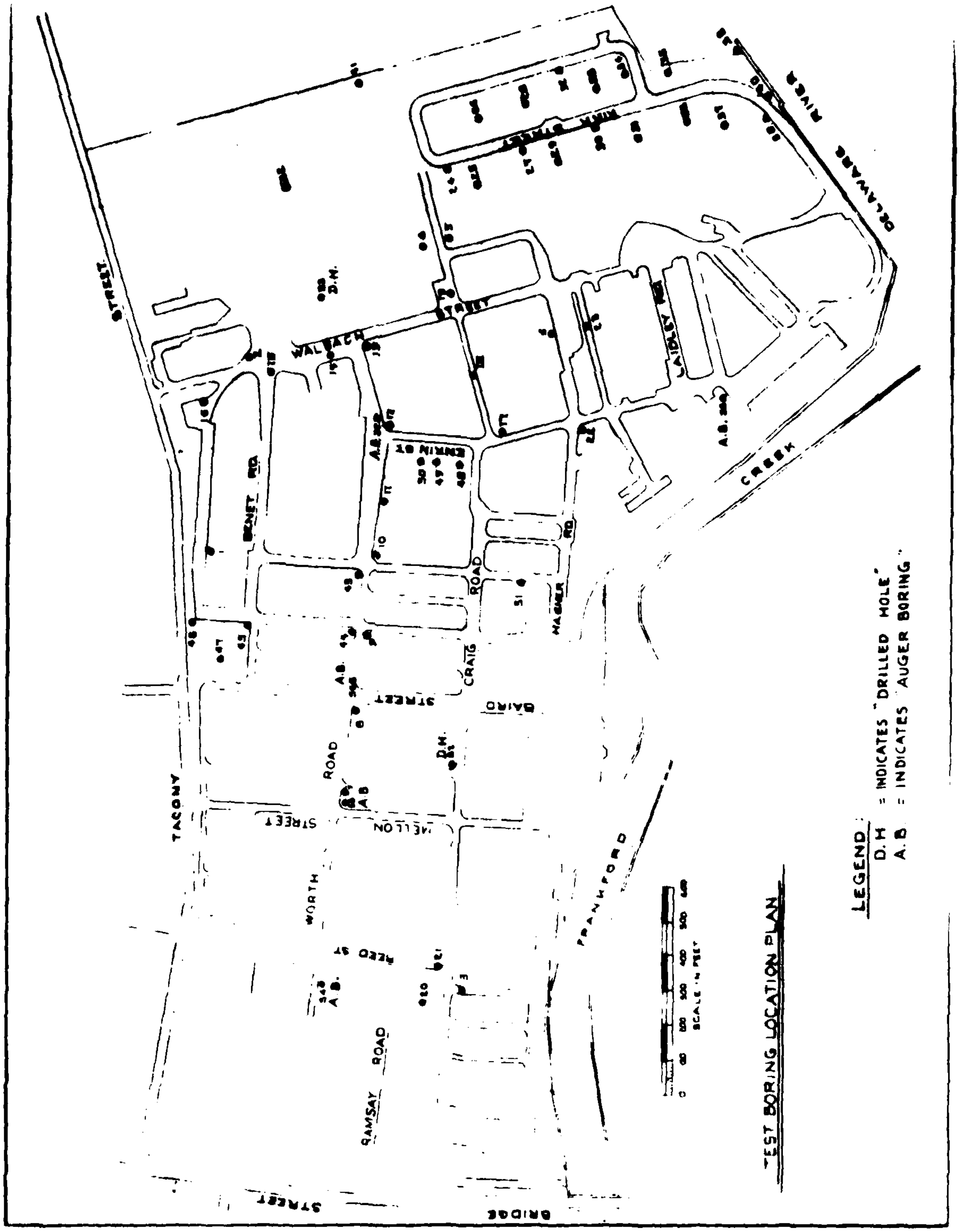
Figure 14a. Bldg 409, the pier. Pipes are intake lines for emergency water.

Figure 15a. Inactive operations buildings, "400 Area".

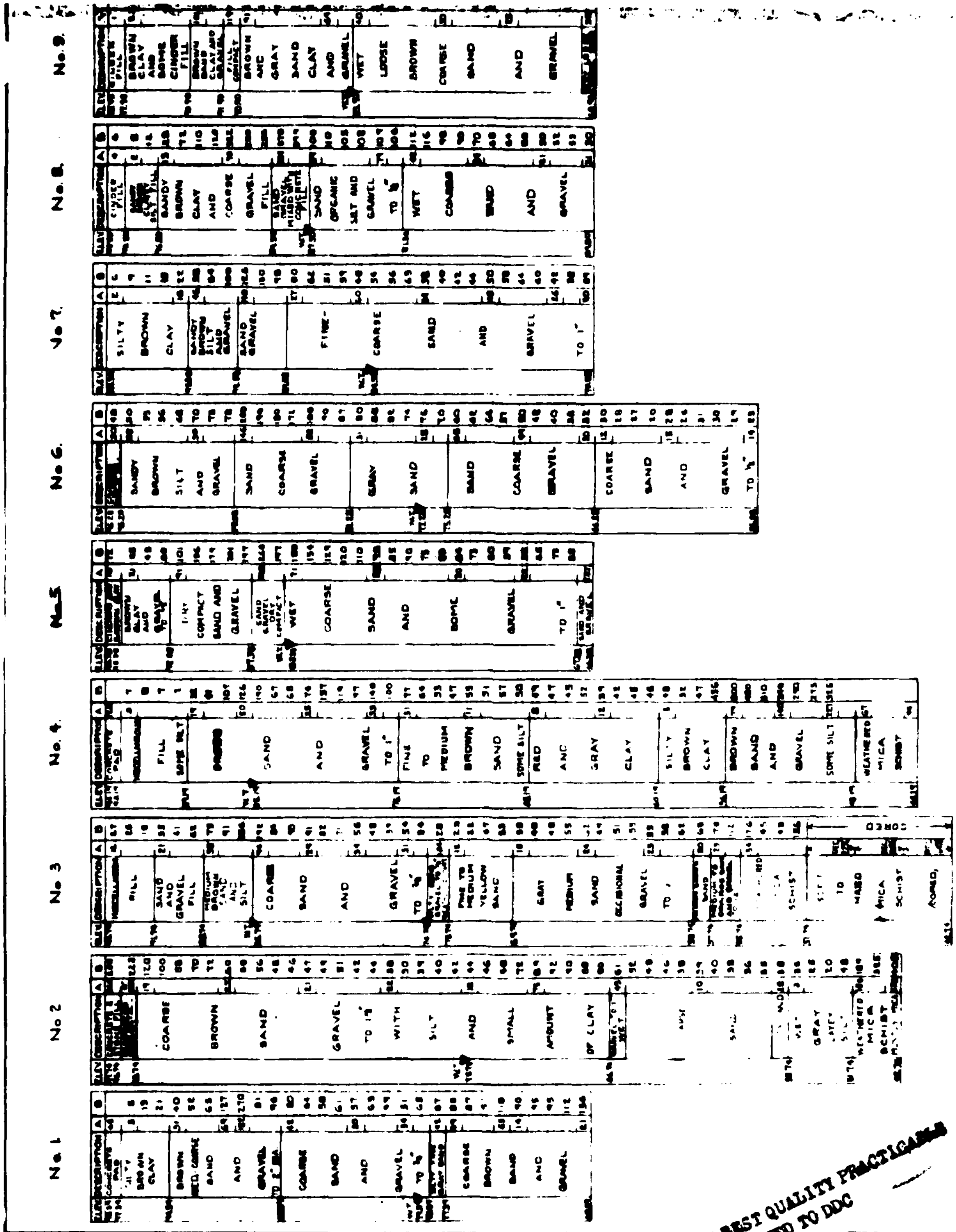
Figure 15b. Inactive operations buildings, "400 Area".

APPENDIX C

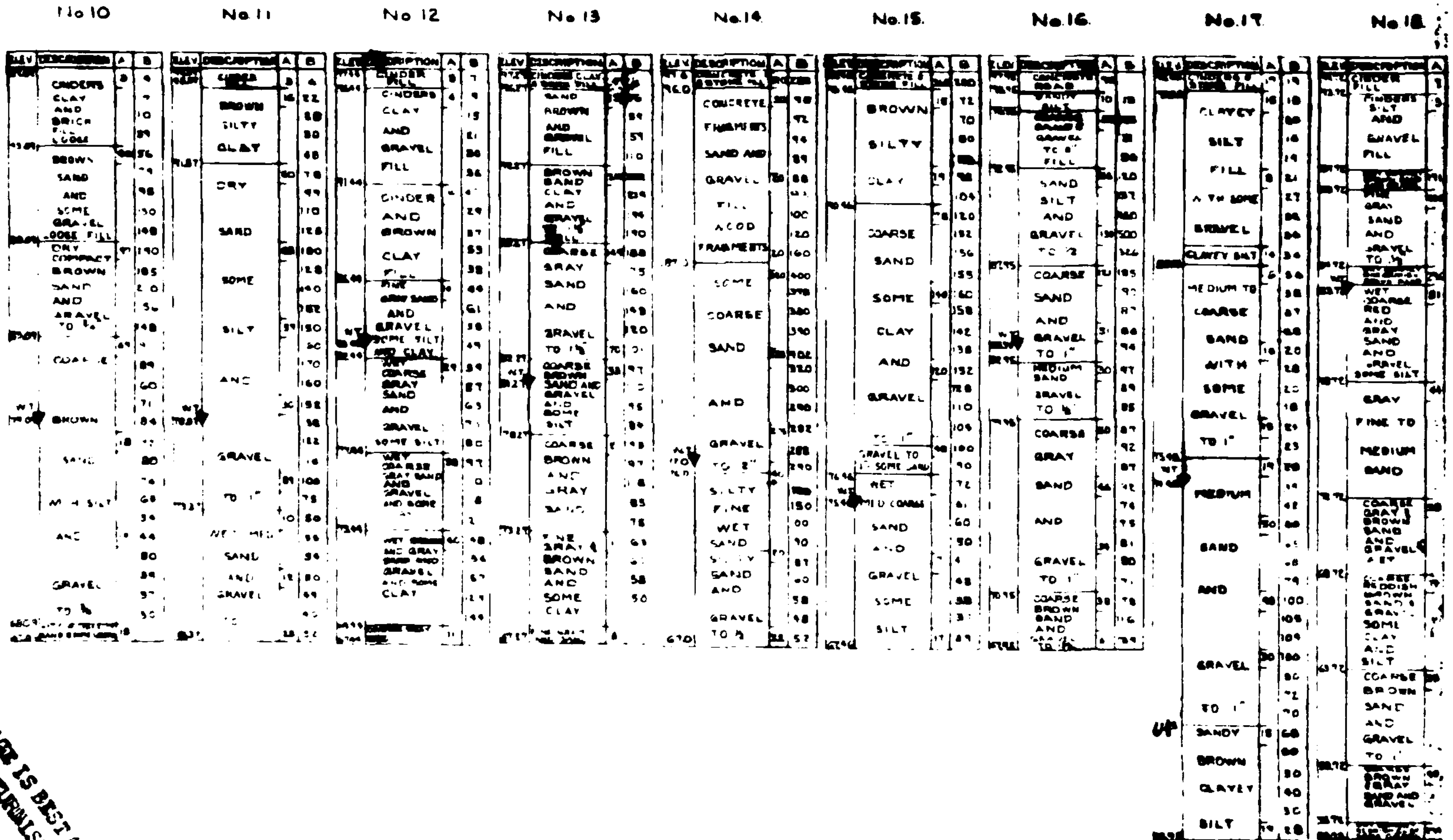
BORING LOGS



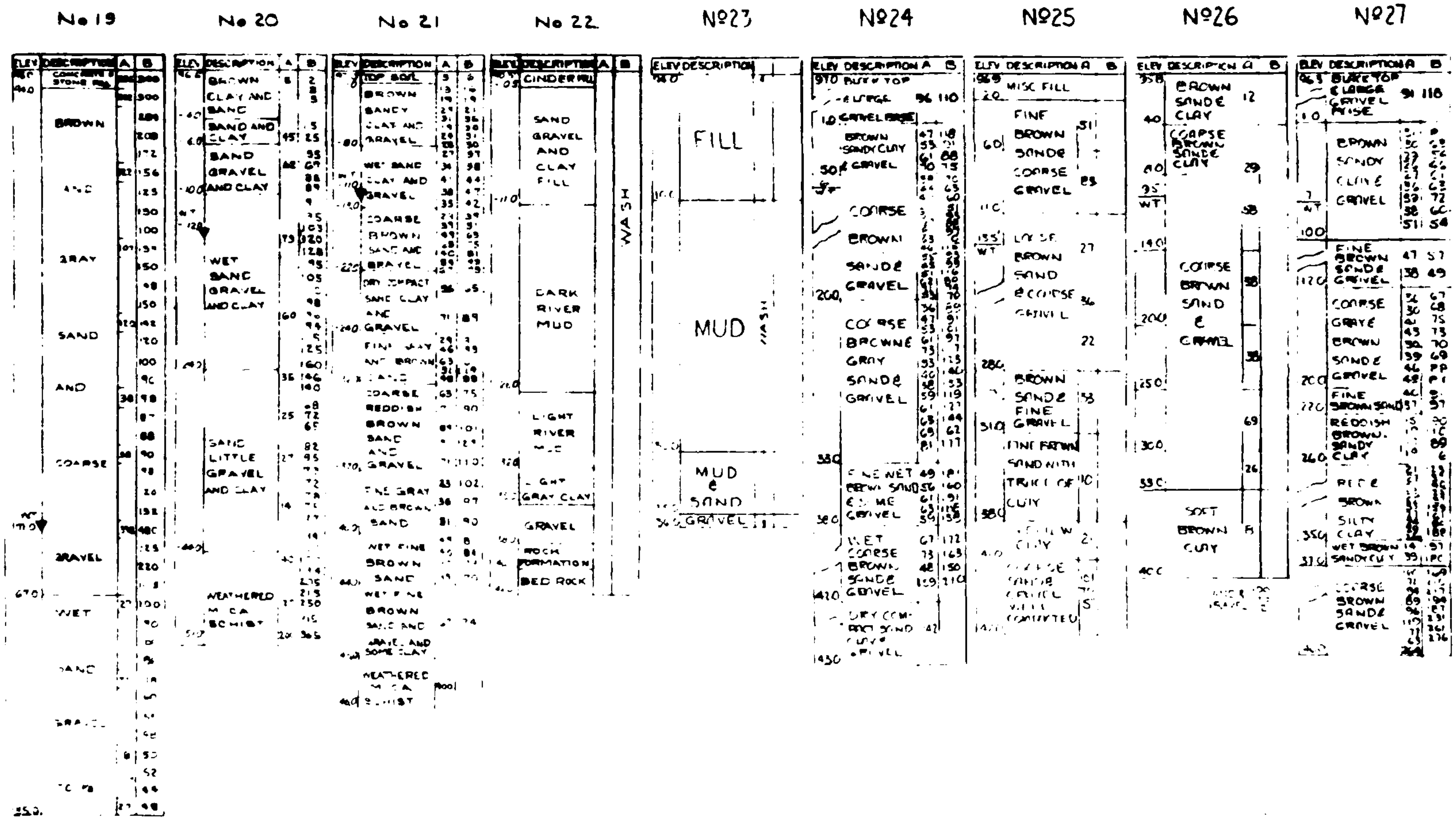
THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC



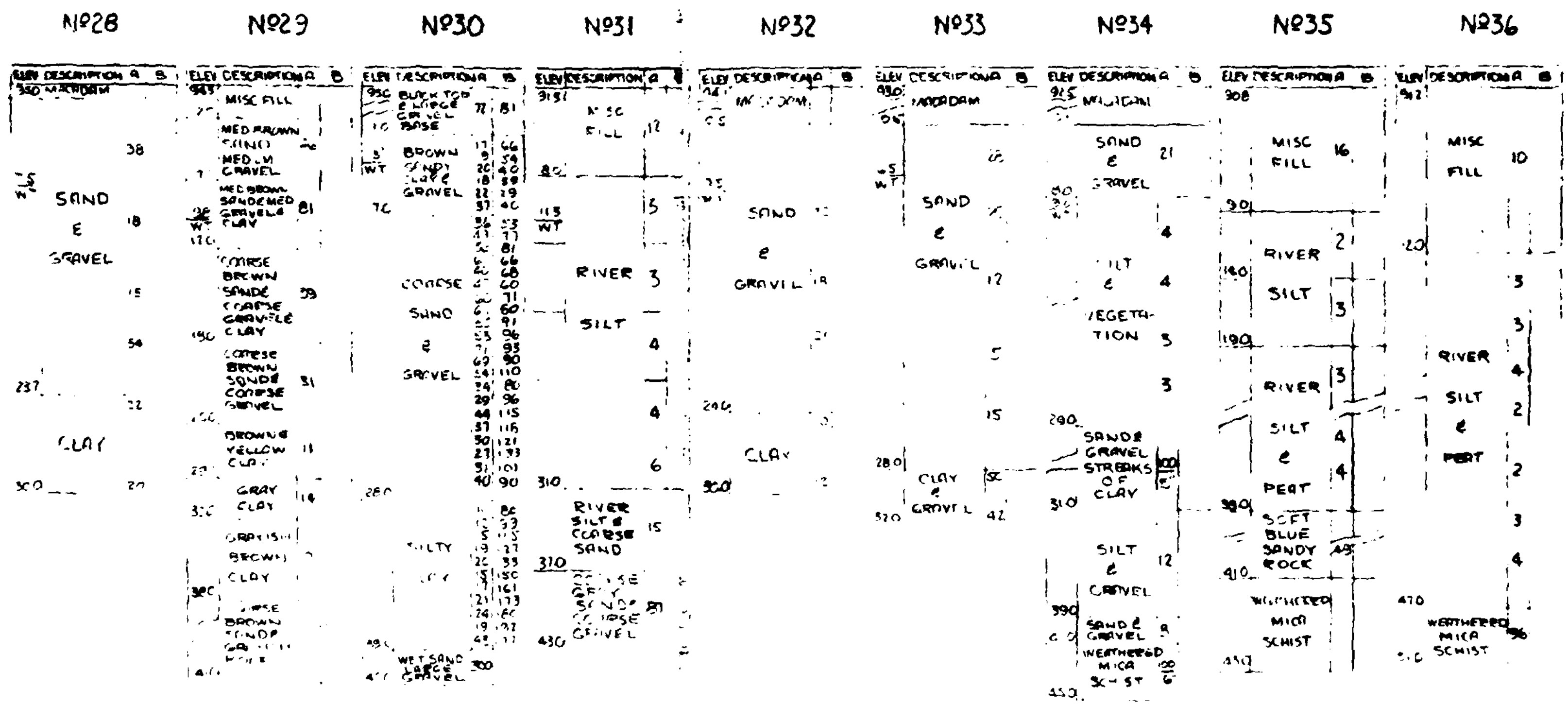
THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC



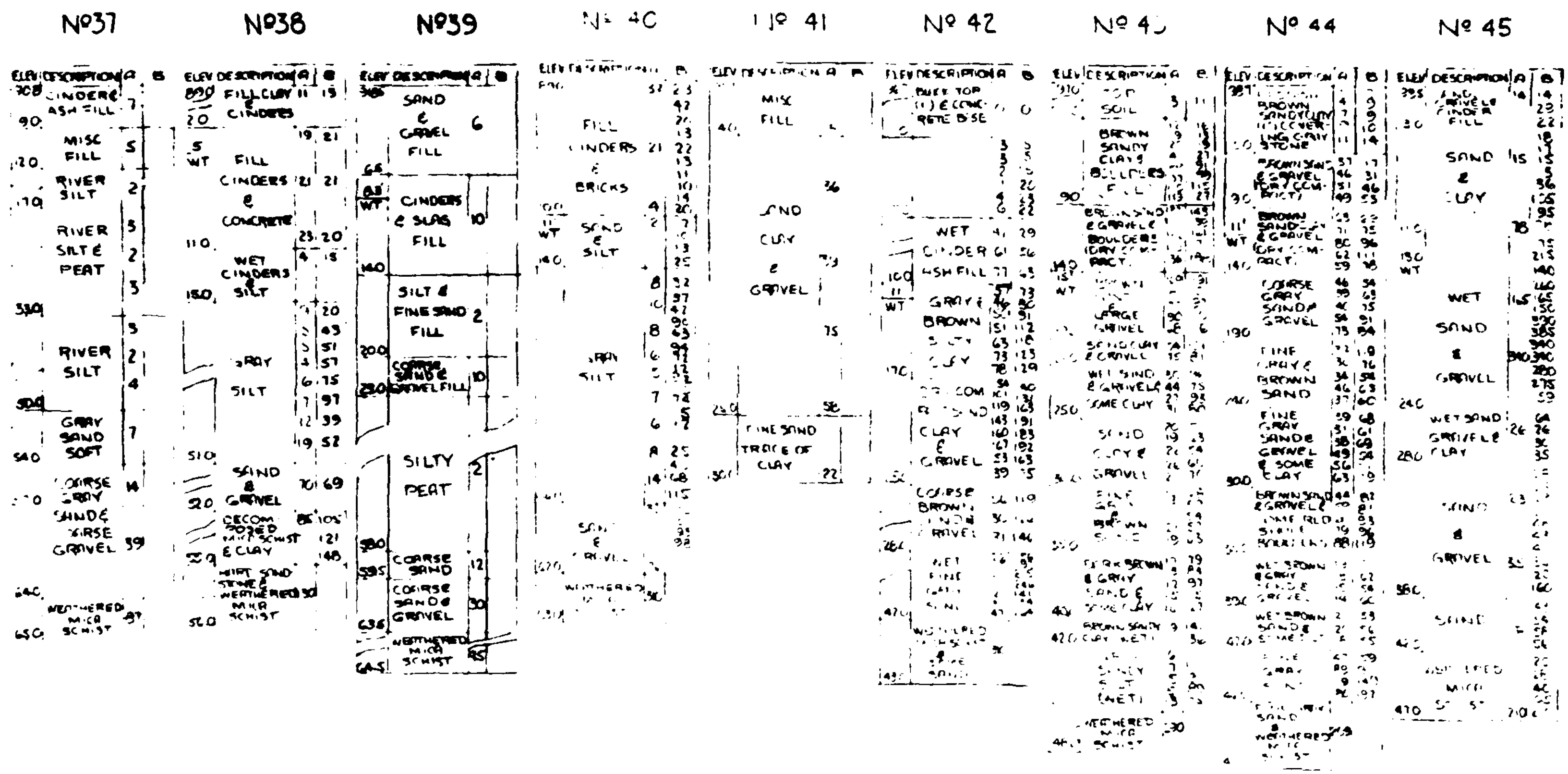
THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC



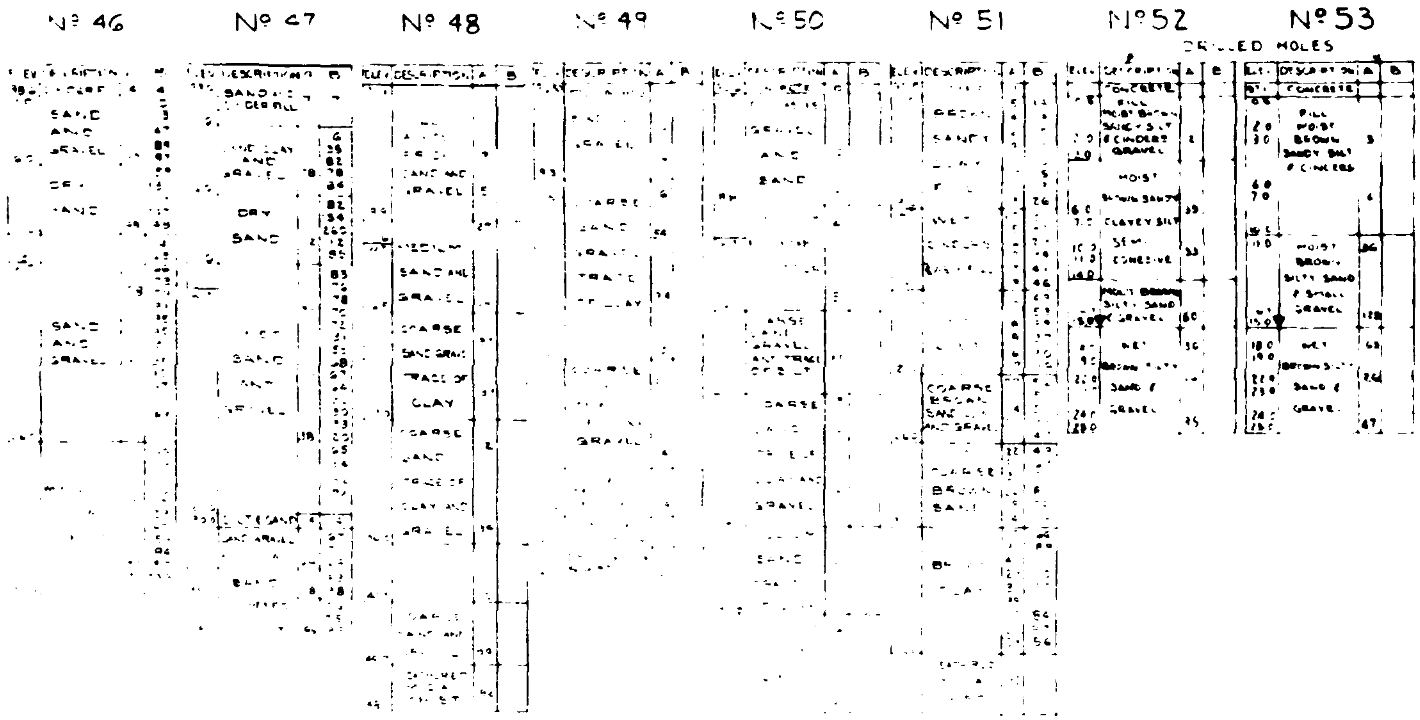
THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC



THIS PAGE IS BEST QUALITY PRACTICABLE FROM COPY FURNISHED TO DDC



THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC



THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

AUGER BORINGS

Nº54

ELEV	DESCRIPTION	A	B
101.0	TOP SOIL MOIST DARK BROWN SANDY CLAYEY SILT		
4.5	MOIST BROWN CLAYEY SILT		
3.0	MOIST BROWN SANDY CLAYEY SILT & GRAVEL COBBLES		
8.0			

Nº55

ELEV	DESCRIPTION	A	B
101.0	FILL MOIST BROWN SANDY SILT GRAVEL CINDERS CRUSH STONE		
1.5	MOIST BROWN SANDY CLAYEY SILT		
3.0	MOIST BROWN SANDY CLAYEY SILT GRAVEL & COBBLES		
10.0			

Nº56

ELEV	DESCRIPTION	A	B
99.0	FILL MOIST & WET BROWN CLAYEY SILT CINDERS CRUSH STONE		
2.0	MOIST BROWN SANDY CLAYEY SILT & SMALL GRAVEL		
12.0			

Nº57

ELEV	DESCRIPTION	A	B
[illegible]	FILL MOIST BROWN SANDY SILT & CINDERS		
5.0	WET BROWN & GRAY SANDY CLAYEY SILT & GRAVEL		

Nº58

ELEV	DESCRIPTION	A	B
	[illegible] BROWN SANDY SILT & GRAVEL CINDERS, BRICK [illegible] GLASS & TIN CANS		
	WET [illegible] SANDY [illegible] SILT [illegible]		

BORING CHRONOLOGY

BORINGS	1 TO 10	OCT. [illegible]
BORINGS	24,27,30,42,43,44,51,21	APR-MAY, [illegible]
BORINGS	38,40	JAN. [illegible]
BORINGS	48,49,50	OCT. 1954
BORING	41	JAN. [illegible]
BORINGS	28,32,33,34,45,46,47,20	JAN-MAY, 1958
BORING	22	AUG. 1951
BORINGS	25,26,29,31,35,36,37,39	MAR. 1941-[illegible] 1942
BORING	23	MADE PRIOR TO 1940
BORINGS	52 to 58 inclusive	OCTOBER 1960

A: BLOWS PER FOOT ON SAMPLING SPOON USING 140LB HAMMER WITH A 30IN DROP AND 2" O.D. SPOON

B: CASING BLOWS-USING 300LB HAMMER WITH 30IN DROP ON 4 IN OD CASING.

SYMBOL (▼) INDICATES WATER LEVEL OBSERVED WHEN BORINGS WERE MADE POROSITY OF THE SOIL STRATA VARIATIONS OF RAINFALL. SITE TOPOGRAPHY, ETC, MAY CAUSE CHANGES AND FLUCTUATIONS IN THE GROUND WATER LEVELS

FOR ADDITIONAL NOTES SEE SHEET No. 4.

REFERENCE DRAWINGS

FOR COMPLETE LIST OF REFERENCE DRAWINGS SEE DRAWING No 71-03-20 SHEET No 1

THIS DRAWING HAS BEEN REDUCED TO ONE-HALF THE ORIGINAL SCALE

REVISION	DATE	DESCRIPTION

ALBERT C. WOOD ASSOCIATES, INC
CONSULTING ENGINEERS
1632 ARCH ST. PHILADELPHIA 3, PA

CORPS OF ENGINEERS, U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
BALTIMORE DISTRICT
BALTIMORE, MARYLAND

DRAWN BY
TRACED BY
REVIEWED & COORDINATED
A/E PRINCIPAL
REVIEWED BY SAFETY BRANCH
SUBMITTED
APPROVED
APPROVED FOR FRANKFORD ARSENAL
DATE

FRANKFORD ARSENAL
PHILADELPHIA, PA

EXPANSION OF ELECTRICAL DISTRIBUTION SYSTEM
(2ND INCREMENT FINAL DESIGN)

TEST BORING PLAN & DATA

APPROVED Warren [illegible] Johnson
DATE 26 APR 61
SCALE NONE
DRAWING NUMBER 71-03-20
SHEET 3

ROBERT E. DERBY — COMMONWEALTH OF PENNSYLVANIA — REGISTERED PROFESSIONAL ENGINEER

THIS PAGE IS BEST QUALITY PRACTICABLE FROM COPY FURNISHED TO DDC

BORING LOGS -- BUILDINGS 47 AND 48

Boring No.	Depth From	Depth To	Soil Classification
Bldg 47			
1	0'0"	0'9"	Concrete
	0'9"	5'6"	Fill - brown fine to medium sand, some gravel, silt, some coal fines (red bricks 3 - 5 ft)
	5'6"	8'0"	Brown fine sandy silt
	8'0"	21'0"	Brown fine to medium and coarse sand and fine to coarse gravel, some silt
	Groundwater at 11'3"		
2	0'0"	0'8"	Concrete
	0'8"	4'6"	Fill - brown silt, trace of fine sand and brick
	4'6"	10'0"	Brown silt, trace of fine sand
	10'0"	21'0"	Brown fine to coarse sand, some fine to coarse gravel and silt
	Groundwater at 11'0"		
Borings completed 10 Apr 75			
Bldg 48			
1	0'0"	3'2"	Concrete floor
	3'2"	8'0"	Brown sandy silt, few pieces of gravel
	8'0"	25'0"	Brown fine coarse sand and gravel, wet
	25'0"	27'0"	Brown fine to medium sand, wet
	27'0"	31'0"	Brown fine to coarse sand-gravel, wet
	Groundwater at 11'4"		
Boring completed 17 Sep 71			

(continued)

Boring No.	Depth From	To	Soil Classification
Bldg 48			
2	0'0"	1'2"	Concrete
	1'2"	5'0"	Medium brown sand, some silt and gravel
	5'0"	9'6"	Medium brown sand and gravel
	9'6"	20'6"	Coarse brown sand and gravel
	20'6"		Hardpan
	Groundwater at 10'8"		
Boring completed 7 Nov 72			

DRILLER'S LOGS FROM ROHM AND HAAS WELLS

Well No.	Location	Altitude (msl) (feet)	Total Depth (feet)	Soil Description (Depth in Feet)		Formation/Member
Ph-324	J23d-8433	11	67	0-25	Sand and gravel	Pleistocene, undifferentiated
				25-45	Yellow and sandy clay	Raritan/Middle clay
				45-65	Sand and gravel	Raritan/Farrington sand
				65-67	Mica rock	Crystalline rocks
Ph-325	J23d-8333	10	80	0-25	Sand and gravel	Pleistocene, undifferentiated
				25-40	Yellow and brown clay	Raritan/Middle clay
				40-60	Fine brown sand & gravel	Raritan/Farrington sand
				60-80	Mica rock	Crystalline rocks
Ph-326	J23d-8332	18	65	0-25	Sand and gravel	Pleistocene, undifferentiated
				25-45	Yellow and red sandy clay	Raritan/Middle clay
				45-58	Brown sand and clay	Raritan/Farrington sand
				58-65	Mica rock	Crystalline rocks
Ph-327	J23d-8330	10	44	0-19	Sand and gravel	Pleistocene, undifferentiated
				19-38	Yellow sandy clay	Raritan/Middle clay
				38-43	Coarse sand and gravel	Raritan/Farrington sand
				43-44	Residual yellow clay & mica	Crystalline rocks

APPENDIX D

SUMMARY OF TRIP REPORTS

DEPARTMENT OF THE ARMY
US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
CHEMICAL SYSTEMS LABORATORY
ABERDEEN PROVING GROUND, MARYLAND 21010

DRDAR-CLT-D

25 July 1977

TRAVEL MEMORANDUM FOR RECORD

SUBJECT: Report of Trip to Frankford Arsenal from 19 to 22 July 1977 by Donald Gross, Albert Deiner, Paul Davis, and George Pankoff

1. Purpose: To provide technical expertise in the organization of the segregation, for disposal, of laboratory chemicals left in storage in the various buildings of Frankford Arsenal and to assist in the development of a Letter of Instruction to personnel who will be completing the task of handling these chemicals.

2. Individuals Contacted:

LTC Wood, Current Commander, Frankford Arsenal
LTC Hackley, former Commander, Frankford Arsenal
COL Greene, ARRADCOM
Mr. Ford, Civilian Executive
Dr. Mikula, former head of Frankford Arsenal Chemical Dept, Pittmann-Dunn Labs
Dr. Matsaguma, ARRADCOM, Large Caliber Weapon Systems Laboratory
Mr. F. Fidell, Chief, Safety Office, Frankford Arsenal
Various former Pittmann-Dunn employees currently employed at ARRADCOM

3. Brief Summary of Discussion: A survey of the building and storage areas, designated by the Frankford Arsenal Safety Office as chemical storage sites, was made. It was ascertained that a potentially hazardous condition existed which required rapid remedial action.

4. Significant Accomplishments/Actions/Recommendations:

a. <u>Actions</u>:

(1) A Letter of Instruction was drafted and submitted to the Frankford Arsenal Safety Office for adoption. This document was reviewed and signed by Mr. McGrath of the CSL Safety Office. A copy is inclosed as incl 1.

(2) The Commander of the installation was briefed on the status of the potential hazards existing on the installation and suggested remedial action was presented.

DRDAR-CLT-D 25 July 1977
SUBJECT: Report of Trip to Frankford Arsenal from 19 to 22 July 1977 by Donald Gross, Albert Deiner, Paul Davis, and George Pankoff

(3) At the request of the Commander the CSL team removed all immediate apparent hazards presented by laboratory sized chemicals and commercial materials stored in various buildings throughout the arsenal.

(4) The collection, consolidation, and segregation of laboratory and proprietary chemicals was systematized into the following categories:

(a) Mineral acids

(b) Mineral bases

(c) Volatile organics

(d) Gases

(e) Carcinogenic compounds

(f) Insecticides

(g) Heavy toxic metals (Hg, As, Cd, Pb, Se)

(h) Commercially valuable metal salts (Ag, An, In, etc.)

(i) Organic laboratory compounds and intermediates

(j) Inorganic compounds

(k) Alkali and alkali earth metals (Na, Li, K, Ca)

(5) The materials from the outlying building were removed and transported to building 64, second floor and segregated in the categories listed above. The buildings visited are listed in incl 2.

(6) In the above efforts the CSL team was given the cooperation and assistance of Dr. Mikula and two former Pittmann-Dunn employees

b. Recommendations and Conclusions:

(1) The collection and segregation of laboratory chemicals has been systematized and qualified personnel are now in a position to continue this effort.

DRDAR-CLT-D 25 July 1977

SUBJECT: Report of Trip to Frankford Arsenal from 19 to 22 July 1977 by Donald Gross, Albert Deiner, Paul Davis, and George Pankoff

(2) A major portion of the arsenal has been surveyed and the vast majority of chemicals have been removed to building 64 for subsequent segregation.

(3) Recommend that the remaining buildings not already covered be investigated for chemicals and potentially hazardous materials.

(4) Recommend that a Frankford Arsenal team, more familiar with the arsenal, resurvey the buildings already covered to insure that nothing was overlooked.

(5) Recommend that the large quantity of mercury, with an approximate market value of $40,000, be sold to recoup the value.

(6) Further segregation of inorganic and organic chemicals should be performed and potentially valuable materials further segregated for resale to commercial; this includes commercial quantities of unopened materials (plating materials, etc.).

(7) A contract for disposal of the remaining materials, excluding the plating solution in tanks in building 46, should be let. A list of EPA approved disposal companies was given to the Frankford Arsenal Closure Office to facilitate this action.

(8) Gas cylinders located throughout the post should be returned to the suppliers to reduce demurrage charges on these cylinders.

(9) Cylinders of Phosgene and bottles of Difluoro have been isolated into a locked room and are to be removed by a Technical Escort team on Tuesday, 26 July 1977.

SUBMITTED BY:

Donald Gross
DONALD GROSS
DRDAR-CLT-D

Albert Deiner
ALBERT DEINER
DRDAR-CLN

2 Incl
as

Paul M. Davis
PAUL M. DAVIS
DRDAR-CLB -KA

George P. Pankoff
GEORGE PANKOFF
DRDAR-CLC

CF:
Cdr, Frankford Arsenal
Cdr, Picatinny Arsenal (Dr. Mikula)
Chief, Mun Div (DRDAR-CLN/A. Deiner)
Chief, Rsch Div (DRDAR-CLB/P. Davis)
Chief, CB Det & Alarms Div (DRDAR-CLC/G. Pankoff)

LETTER OF INSTRUCTIONS FOR HANDLING CHEMICALS IN FRANKFORD ARSENAL

PURPOSE.

The purpose of this letter of instruction is to act only as a general guide to the personnel of the chemical separation and segregation team and is not intended to be applicable to each and every special situation that might arise. The objective of the team will be to properly sort and segregate a wide variety of chemicals into compatibility groups to minimize safety hazards until their disposition is effected.

SCOPE.

These instructions will be followed by team personnel in separating and transferring all laboratory quantities of chemicals in buildings within Frankford Arsenal.

OPERATING INSTRUCTIONS.

1. Only duly qualified personnel based on background and experience in chemistry will direct work described within these instructions.

2. While carrying out the duties described below, each team member is required to wear protective clothing consisting of rubber gloves, rubber apron or coveralls and suitable eye protection, e.g., shields, safety glasses, etc., and any required safety devices required for specific applications, e.g., face mask, respirators, etc.

3. Each team member will be familiar with the location and operation of fire extinguishers, fire alarms, safety showers and eye wash fountains in buildings listed in scope of these instructions.

4. No team member will be permitted to work alone during the sorting, separating and transporting of chemicals.

5. Each team member will be briefed on safety precautions to be taken during performance of assigned duties and will be provided with neutralizing compounds to be used in the eventuality of an accidental chemical spill.

6. All team leaders will be furnished with and be required to read and acknowledge their understanding of the Feltman Research Laboratories Safety Manual (attachment 1). They will also be furnished with a copy of and will be required to become familiar with the revised list of controlled substances and carcinogens (attachment 2).

7. All personnel of the team are required to wash their hands and face after each and every sorting operation and especially before eating.

No eating will be permitted by team members in areas containing chemicals.

8. Team members are not to open, smell or touch any chemicals regardless of label designation and, therefore, combining of partially consumed common

Inc 11

chemicals for the purpose of consolidation is prohibited, as also is dumping of any chemicals into the drains, sewage system, water ways or atmosphere.

9. All chemicals bearing labels will be identified and sorted into one of the following categories: volatile solvent, mineral acid, strong oxidizer, strong reducer, carcinogenic material, controlled substance, explosive or hazardous material or if not applicable to one of these categories, then the more general category of inorganic compound.

10. All chemicals except the volatile solvents will be placed in a holding area on the second floor of Building 64, consisting of a suite of six rooms, accessible from the hallway only be entrance through doors numbered 200 and 202.

11. Each room of the holding area will be posted with signs and will be used to store the group of compatible chemicals for which it is designated.

12. Rooms in the chemical holding area will be off limits to all personnel except designated team members and team members are requested to enforce this rule if unauthorized personnel are seen in the area.

13. Access to all rooms on the second floor of Building 64 containing chemicals awaiting transfer to the holding area will be locked and secured at all times except when team members or other duly authorized personnel are working in them.

14. Keys for all secured areas, including the chemical holding area, will be strictly controlled by the team coordinator, Dr. Mikula, and one other person whom he designates.

15. Absolutely no smoking will be permitted on the second floor of Building 64. To insure compliance with this request, a sufficient number of signs will be prominently displayed in Building 64, at the entrances to the second floor, on doors along the hallway of the second floor and on the elevators leading to the second floor. In addition, a member of the Fire Department is to make periodic daily walk-throughs of the second floor areas to enforce the no smoking rule, and team members are also requested to assist in the enforcement of the no smoking regulation.

16. Highly volatile and flammable solvents will be separated and transferred from Building 64 to the shed area adjacent to Building 65, which had previously been used at Frankford Arsenal for such purposes. The solvents will be stored in the shed awaiting final disposition. Restrictions, with regard to smoking, personnel access, and key control, as outlined in paragraphs 8 through 11, inclusive, will also apply to the solvent shed area.

17. All unlabelled bottles, jars, or reaction flasks containing chemicals are to be treated as potentially hazardous materials and as such will be cautiously segregated and placed under a fume hood in the holding area designated and tagged for such substances. The area should have a sign clearly affixed to it with a warning of the presence of potentially dangerous chemicals.

18. All non-toxic compressed gas cylinders will be transferred and consolidated in a holding area in the basement of 64 Building. The cylinders are to be tied down by either a chain or heavy rope to prevent them from tipping over. Cylinders containing toxic gases are to be placed with the toxic chemicals and secured in the same manner as non-toxic gas cylinders.

19. Mr. F. Fidell, FFA Safety Director will act as overall coordinator for the entire operation including final decontamination and disposal of all chemicals on post. He will keep the FFA Closure Office informed of the progress being made. In addition, he will inform the Post Dispensary, Fire Department and Security Office within FFA of the chemical separation and segregation operation and request them to take whatever standby actions are necessary.

James J. Mikula

DR. J. MIKULA
Team Coordinator (ARRADCOM)

F. FIDELL
FFA Safety Director

Robert J. McGrath

ROBERT J. MC GRATH
Safety Engineer
CSL APO (ARRADCOM)

DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL	SUBJECT
SAREA-BL	Revised List of Controlled Substances

TO See Distribution

FROM COL Lewis C. Miner, Narcotics Control Officer

DATE 10 Mar 77

CMT COL Miner/rmv/3525

1. In accordance with par 5g(10) of EWAR 40-1 dtd 23 November 1976 the attached list of substances controlled since enactment of the Controlled Substances Act of 1970 is forwarded to update Annex A of above regulation and the Controlled Substances Inventory List, revised January 1975, Drug Enforcement Administration.

2. Special attention is invited to the following drug actions:

a. Dextropropoxyphene (Darvon) - added to controlled substances list as of 14 Mar 77 under Schedule IV.

b. Apomorphine and Dextrorphan are no longer controlled as scheduled drugs.

c. Naloxene (Narcan) and Levallorphan (Lorfan) are not controlled substances.

d. Chlordiazepoxide (Librium) and Diazepam (Valium) were added to the controlled substance list in 1975.

3. The attached list should be filed for reference with the custodian's log book.

1 Incl
as

LEWIS C. MINER
COL, MSC
Narcotics Control Officer

DISTRIBUTION:
Dir of Biomed Lab
Dir of Cml Lab
MAJ J. M. Linn, Biomed Lab
CPT J. H. McDonough, Biomed Lab
Dr. C. Broomfield, Biomed Lab
Mr. R. McHugh, Cml Lab
Mr. M. Christensen, Cml Lab
Mr. W. Lennox, Cml Lab

The following is the current list of Chemical Surety Material which requires special controls as prescribed and regulated by the Surety Office:

302,196

EA 3834

EA 3990

EA 5365

BZ (2-Quinuclidinyl Benzilate) EA 2277, CS 123669, CS 4030

CX (Dichloroformoxime or Phosgene Oxime)

GA (Tabun)

GB (Sarin)

GD (Soman)

GF (EA 1212)

H (Levinstein Mustard)

HD (Bis (2-chloroethyl) Sulfide, Distilled Mustard)

HL (Mustard Lewisite)

HQ (25-30% Q and 70-75% H)

HS

HT (60% HD and 40% T by weight)

L (Lewisite)
(2-Chlonovinyldichlonoanisine)

Q (1,2-Bis (2-chlonoethylthio) ethane)
(Sesquimustard)

T (Bis (2-chlonoethylthi..ethyl) ether)

HN1 (Bis (2-chlonoethyl) ethylamine)

HN2 (Bis (2-chlonoethyl) methylamine)

HN3 (Tris (2-chloroethyl) amine
(Nitrogen mustard)

VX (EA 1664)

VX (EA 1701)

DF (difouro methyl phosphine oxide) EA 1251

QL (Diisopropylaminoethyl Ethyl methylphosphonite), Trans ester, EA 1724

AC (Hydrogen Cyanide or Hydrocyanic Acid)

CG (Carbonyl Chloride or Phosgene)

CK (Cyanogen Chloride)

The following is a list of those chemical compounds considered to be carcinogens:

- 4-Aminodiphenyl
- ✓Benzidine
- beta-Naphthylamine
- 4-Nitrodiphenyl
- Dis-Chloromethyl ether
- Methyl chloromethyl ether
- 2-Acetylaminofluorene
- 3,3'-Dichlorobenzedine (and its salts)
- 4-Dimethylaminoazobenzene
- Alpha-Naphthylamine
- N-Nitrosodimethylamine
- beta-Propiolactone
- 4,4'-Methylene bis (2-Chloroaniline)
- Ethyleneimine
- Vinyl Chloride
- ✓Benzene

For more specific information refer to SAREA Pam 385-1, Chapter 6.

MEMORANDUM FOR RECORD

Subject: Search and Consolidation of Laboratory Chemicals at Frankford Arsenal 19-22 July 1977

The purpose of this trip was to collect, consolidate, and segregate laboratory quantities of chemicals at Frankford Arsenal. Additionally, the "Letter of Instructions for Handling Chemicals" was reviewed and comments made accordingly.

The following buildings were inspected for laboratory quantities of chemicals, collected and brought to building 64 (the centralized area) for segregation into volatile solvent, mineral acid, strong oxidizer, strong reducer, carcinogenic material, controlled substance, explosive/hazardous material, or general category of inorganic compound.

Buildings inspected:

Bldg 39 Paints, one tank of enamel thinner, one tank of synthetic enamel (left as is).

Bldg 39 (storage shed) 15 5-gallon drums of Dioxane (left as is).

Bldg 46-B Emptied two storage cabinets of lab chemicals and transported to building 64.

Bldg 46-1 Emptied two laboratories of large quantities of lab chemicals and transported to building 64.

Bldg 46-2 Removed various lab chemicals and transported to building 64.

Bldg 46 Contains large quantities (commercial) of caustic, nitric, chromium hydroxide, and mercuric oxide. There are numerous plating baths located on the first floor of this building containing various mixtures of acids which have to be disposed of commercially. The shed outside of building 46 contains a variety of thinners, paints, and commercially identified plating additives which cannot be chemically identified.

Bldg 48 Heat treatment building. Contains commercial quantities of nitric acid, zinc phosphate, and an outside storage tank of sulphuric acid, also large quantities of caustic. No laboratory level chemicals were found in this building. There were seven drums of chlorinated napthalene also located in this building.

Incl 2

Bldg 55	Paint shop (east end). 33 20-gallon drums of phosphorb cleaner (acid), drums of granodine and deoxylyte. Flammable paints and 21 boxes of flammable metal bond are also located in this building. No laboratory quantities of chemicals were found in this building.
Bldg 108	Optical manufacturing. The first, second, third, and fourth floors were inspected which produced large quantities of laboratory quantities of chemicals. All were transported to building 64. No commercial quantities of chemicals were in this building.
Bldg 108 (shed)	Contains numerous unidentified chemicals. Removed lab chemicals to building 64.
Bldg 112	Welding shop. No chemicals of any kind were to be found in this building.
Bldg 120	Contained commercial quantities of oxident - 300 pounds; however, no lab quantities of chemicals were located in this building.
Bldg 149	(Metallurgy) Numerous quantities of lab chemicals were found and transported to building 64. Additionally, approximately 500 pounds of mercury was transported to building 64. No commercial quantities could be located in this building.
Bldg 150	An average amount of lab quantity of materials were located and transported to buidling 64. No commercial quantities of chemicals were to be found in this building.
Bldg 212-2	Contains 25 gallon drums of muriatic acid but no chemicals.
Bldg 216	Contains commercial quantities of Ketone, formic acid an cyanide but no lab quantity of chemicals.
Bldg 217	Contains 26 gallons of muriatic acid, 200 pounds of oakite and three 25-gallon drums of nitric acid.
Bldg 217 (shed)	Contains commercial quantities of sulphuric acid only.
Bldg 215-1	Variety of lubricant oils only.
Bldg 215-2	Two 100 pound drums of sodium hydroxide. No lab chemicals.
Bldg 251-1	Plastics manufacturing. Removed small quantity of lab chemicals to building 64.

Bldg 251-1 and Bldg 251-2	Contained large quantities of Marlex, bakelite, nylon, resin, alathon, ethoglass, leranzytel, strafil, polycarbonate resin, fiberfil, polytron and polystyrene used in the plastics manufacturing field. These materials were left in building 251.
Bldg 68	No chemicals found either commercial or lab quantities. Highly contaminated with mercury - needs decontamination.
Bldg 239	Clean - no chemicals, oils, or lubricants.
Bldg 242	Removed lab quantities of chemicals and transported to building 64. 55-gallon drum of alcohol still stored.
Bldg 246A	Clean of chemicals, oils, lubricants, etc.
Bldg 247A	Latrine - clean.
Bldg 247	Numerous lab chemicals transported to building 64.
Bldg 248	Clean of chemicals, oils, lubricants, etc.
Bldg 246	One 50-gallon drum of lubricating oil.
Two transtainers south of Bldg 246	Removed large quantities of lab chemicals and transported to building 64. Items remaining: Two 25-gallon drums of grinding fluid One 5-gallon drum of freon fluorocarbon One 5-gallon drum of polyvinyl acetate
Bldg 248A	Munitions and gunpowder; no chemicals.
Bldg 240	No chemicals, oils or lubricants.
Bldg 239A2	Clean - no chemicals, lubricants, etc.
Bldg 239C1, 239C2, 239C3, 239C4	Clean - no chemicals, lubricants, etc.
Bldg 239D3, 239D2, 239E	Clean - no chemicals, lubricants, etc.
Bldg 239 storage shed	No chemicals. Contains one 50-gallon drum of caustic soda commercial quantity.
Bldg 513	Metallurgy building. Removed lab chemicals to building 64.
Post Dispensary (Mrs. Luce, Chief)	All narcotics were moved to Ft Dix. When final close-down occurs, all medicines and chemicals will be moved to Ft Dix.

Bldg 59 — No lab chemicals. Commercial quantities of the following:
- Two cases ethylene glycol
- Six 5-gallon drums of butauol
- Five 50-gallon drums of alcohol

Bldg 439 — Lab quantities of oxidizers brought here.

Bldg 44 — (Receiving) No chemicals, lubricants, oils, solvents, etc.

Bldg 65 — Removed large quantities of lab chemicals to building 64.

Bldg 61A — No lab chemicals. Consolidated and stored 1550 pounds of mercury in this building.

Bldg 61B — No lab chemicals. Contains a variety of plating mixes which were unidentifiable.

Bldg 61C — Empty

Bldg 61D — Removed small lab quantities of chemicals and transported to building 64. Remaining commercial quantities of the following:
- Two drums ammonium bi-fluoride.
- Also oils, paints, parafin, chronic acid, NaCl and napthalene and hexalene.

Bldg 60 (shed) — No lab chemicals. Commercial quantities of oils, lubricants, and greases. One 50-gallon drum of absolute alcohol; three drums of solvents; several empty drums (50 gallon).

Transtainers next to building 60

Transtainers 1 and 2 contained large quantities of lab chemicals which were transported to building 64. Transtainer 1 contained two small cylinders of phosgene which were moved to building 64 in a safety area. EWA Tech Escort was immediately notified and will pick up the phosgine on 25 July 1977.

Transtainer 2 contained commercial quantities of the following:
- Four gallons naptha
- Thirty-seven gallons sodium silicate
- Two to five gallons of Woodtox pre-primer
- Four to five gallons fire retardant #25 dated 11-23-71
- One to five gallon drum of unknown solvent

Summary

Upon arrival to Frankford Arsenal a list of buildings (16) was provided to EWA personnel where lab quantities of chemicals were known to exist. At the completion of the TDY period a total of 58 buildings, sheds, and transtainers were examined for lab chemicals. It appears that further lab quantities of chemicals will be found in other buildings, sheds, and transtainers that were not inspected by EWA personnel.

Many buildings contain cylinders of nitrogen, hydrogen, acetylene, oxygene, etc. in commercial quantities. They should be consolidated in one area and returned to contractors such as "Luide." Oils, lubricants, solvents and trade name or manufacturer coded chemicals, etc. should also be consolidated into one area.

MEMORANDUM FOR RECORD 29 July 1977

Subject: Summary of Building Revisit 2

To: Consolidation Team

1. Building 39. The items remaining were:

   a. Four solvent cans partially filled; on work bench.

   b. Paint and related materials on three carts; one out in the work area and two in the storage room (1st floor).

   c. Ten each 5-gallon containers of Dioxane.

   d. Twenty-two boxes (50 pounds) of Pangboxnite abrasive (1st floor).

   e. 55-gallon drum of turpentine.

   f. Ten one-gallon bottles of leather dye.

   g. 5-gallon pail of enamel paint in basement locker room.

   h. Twenty-four 5-gallon cans of thinner and twelve (approximately) 1-gallon cans of thinner in outside transportainer.

2. Building 46

   a. Took six bottles of lab chemicals to building 64.

   b. Minor amount of adhesive and potting compounds still on benches.

   c. Commercial quantities of plating materials, paints, and potting compounds on 1st floor, basement, and sheds, as previously reported.

3. Building 48

   a. Many 55-gallon drums in front open shed.

   b. Commercial quantities of chemicals and paints, as previously reported.

   c. Gas cylinder.

4. Building 61

Four boxes of chemicals sitting outside. Removed to building 64.

5. Building 58

Solvents moved to building 64. Six acelylene and two O_2 cylinders on 1st floor.

6. Building 55, NE end

Paints and associated materials. Removed metal bond cans and five gallons of butanol to building 64.

7. Building 108

Took chemicals to building 64, 1st floor. Helium cylinder on 2nd floor coating room lab. Miscellaneous coatings, paints, and related materials still there. Took solvents to building 64, 3rd floor; 4th and penthouse clear of chemicals. Large CO_2 cylinder in penthouse.

8. Building 112

Many cylinders of O_2, Acct, Argo, etc., cutting oils, solvents in 55-gallon drums in alcone area, and machine shop area - 30 drums. 2nd floor, 5-gallon cans of solvent in six cans. 3rd floor - clear. The tank with solvent. Acetylene tanks in tool and cutter ground area, in other wing, cutting compounds. 55-gallon drum of cleaning solvent, 1 Barisol. 4th and 5th floors clean.

9. Building 120

No chemicals per Art Hobson.

10. Cabinet with metal powers, and metal working materials (polishes, etc.). Many gas cylinders, O_2 and Acct. CO_2, drums of oil (55-gallon), and five drums of blackshop molasses.

11. Building 150

First NE end of drums (55-gallon of solvents). 2nd floor clean.

12. Buildings 216 and 217

Cleaning tanks still full. Commercial amount of solvents and cleaners; phosphoric acid tank still full (2nd floor). 1st floor, drums of caustic (four) oil drums on loading dock.

DEPARTMENT OF THE ARMY
US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
CHEMICAL SYSTEMS LABORATORY
ABERDEEN PROVING GROUND, MARYLAND 21010

DRDAR-CLT

19 SEP 1977

CF: Don Gross, Environ Tech Div

TRAVEL MEMORANDUM FOR RECORD

SUBJECT: Report of Trip to Frankford Arsenal (FA), Philadelphia, PA, 28 July Through 4 August 1977 by A. Deiner, D. Gross, R. Kassell, G. Norris, and R. Yon

1. Purpose: The purpose of this trip was to search various assigned buildings at FA for chemicals and remove these to a central location for sorting into various subgroups, and removal to safe locations for storage pending subsequent disposal by a contractor.

2. Individuals contacted:

LTC Wood, Cdr, FA
Dr. Mikula
Mr. F. Fidell

3. Brief summary of discussion: Very few discussions were held during this period. Mainly work was performed on removing chemicals, sorting into subgroups, boxing and removing to various storage locations to minimize fire hazards.

4. Significant accomplishments/actions/recommendations:

a. The task of removing chemicals from various locations on FA, sorting, and removal to safe locations is essentially complete. The chemicals were separated into the following categories:

Organic Solvents - over 100 gallons were separated and removed from bldg. 64 to an organic solvent storage area.

Organic Chemicals - about 4000 various compounds were collected and sorted and placed in steel storage cabinets in bldg. 64.

Carcinogenic Compounds - approximately 10 lbs. of these compounds were isolated and individually packed in steel ammunition boxes surrounded by vermiculite. Each container was clearly marked as to contents and with warning legend. These materials were removed from bldg. 64 for storage in locked containers (bldg. 61C).

DRDAR-CLT 19 SEP 1977

SUBJECT: Report of Trip to Frankford Arsenal (FA), Philadelphia, PA, 28 July Through 4 August 1977 by A. Deiner, D. Gross, R. Kassell, G. Norris, and R. Yon

Organo Mercurials, Organo Arsenicals, Fungacides, Insectides - approximately 40 lbs. of compounds of this type were packed in steel ammunition boxes surrounded by vermiculite. Each container was clearly marked as to contents and with warning legend. These materials were removed from bldg. 64 for storage in locked containers (bldg. 61C).

Shock Sensitive and Potentially Explosive Organic Preparations - under direction of Dr. Matsuguma of Picatinny Arsenal, these materials were separated, packed and marked, and stored by the procedure described. These materials were removed from bldg. 64 for storage in locked container in bldg. 61C.

A small amount of material that was heat sensitive was left in the freezer in bldg. 64. The freezer was clearly marked as to contents and with warning legend. Small quantities of nitroglycerine was destroyed by Dr. Matsuguma.

Propellants and other explosives were collected and stored in locked magazines.

Inorganic Strong Acids and Bases (Ammonium Hydroxide) - over 100 gallons of these materials were collected and removed from bldg. 64 to a storage area.

Inorganic Chemicals - well over 500 various compounds were sorted and placed in marked steel storage cabinets in bldg. 64.

Inorganic Heavy Metals (Arsenic, Mercury, etc.) Compounds - over 75 compounds of this type were isolated and placed in marked shelves in steel storage cabinets in bldg. 64.

Alkali Metals (Li, Na, K, Rb, Cs) and Alkali Earth Metals (Ca, Sv) - about 20 lbs. of these materials were collected and packed in steel ammunition boxes, marked, and removed from bldg. 64 to locked storage in bldg. 61A.

Poisonous Inorganic Compounds (Berylbium) - about 5 lbs. of these materials were collected, packed as previously described and removed from bldg. 64 for storage in bldg. 61A.

Commercial Oils, Lubricants, Hydraulic Fluids - more than 200 gallons of these materials were collected and poured into 55-gallon drums for disposal by contractor.

Commercial Materials, Unknown Chemicals, Paints, Thinners, Etc. - hundreds of commercial materials and unknown chemicals, paints, thinners, etc., were sorted and stored in clearly marked cartons in bldg. 64.

Compressed Gases - large numbers of cylinders of compressed gases were removed from various locations and stored in the basement of bldg. 64.

Some gases were removed by the commercial vendor during the week of 1 August and arrangements were complete to remove the remaining compressed gases during the week of 8 August 1977.

LTC Wood inspected the results of the CSL team effort at 1500 hours, 5 August, and complimented and thanked the personnel for their efforts. There remains very minor work to be completed involving removing of the remaining volatile solvents to storage sheds, sweeping floors, etc. LtC Wood agreed to release the CSL personnel. We recommended the searched buildings be locked and access to these areas be controlled. LTC Wood said this was not possible because of removal of machinery and equipment from these locations and the lack of personnel to secure these areas.

b. At the close of the business day on 29 July 1977 there was approximately 2500 lbs. of metallic mercury stored under lock and key in bldg. 61A. About 2000 lbs. of the mercury was contained in 30 steel flasks while the remainder was in plastic bottles or ceramic flasks.

On 2 August 1977 it was discovered that bldg. 61A was broken into and that the 30 steel flasks were missing. The remaining 500 lbs. of mercury was untouched. This loss was reported to LTC Wood and he was briefed as to the toxicity of mercury and its potential hazard to the environment. An investigation by the FA Security Office was made and Mr. Deiner was questioned.

c. Recommendations:

(1) Greater security be implemented by FA to insure the integrity of the toxic materials being stored there; and

DRDAR-CLT 19 SEP 1977

SUBJECT: Report of Trip to Frankford Arsenal (FA), Philadelphia, PA, 28 July Through 4 August 1977 by A. Deiner, D. Gross, R. Kassell, G. Norris, and R. Yon

(2) A notification of all purchasers of scrap mercury that about a ton of metal may appear on the market should be made by FA.

Submitted by:

Albert Deiner
ALBERT DEINER
Munitions Division, CSL

Donald Gross
DONALD GROSS
Environ Tech Div, CSL

Ronald Kassel
RONALD KASSEL
Research Division, CSL

for Roy Yon
GEORGE NORRIS
Developmental Support Div, CSL

Roy Yon
ROY YON
Munitions Division, CSL

1 Incl
Inventory of Buildings Searched by G. Norris and R. Yon

CF:
Chief, Environ Tech Div
Chief, Munitions Division
Chief, Munitions Division (A. Deiner)
Chief, Research Division (R. Kassell)
Chief, Environ Tech Div (D. Gross)
Chief, Developmental Support Div (G. Norris)
Chief, Munitions Division (R. Yon)
Cdr, Frankford Arsenal
Cdr, Frankford Arsenal (Mr. F. Fidell, Safety Dir)
Cdr/Dir, LCWSL (DRDAR-LCE/Dr. J. Mikula)

INVENTORY OF BUILDINGS SEARCHED

BY G. NORRIS AND R.YON

Building	
39	Commercial quantities paints, thinners, polishes, paint removers, mineral spirits, dyes, turpentine, acylic retarders
46	1st - Commercial quantities trichlor, MEK, ethylene glycol (monobutyl) being used; Forming acid (being used)
	2nd - Soldering acids, cleaners, thinners being used
	Shed - Flux, solvents, plotting solutions, paints, resins. Water leaked into this building. Very strong fumes emanating from this shed.
108	2nd - Helium bottle Acids in baths Urethane primers Potting materials Adhesives Oils Lubricants All in commercial quantities or being used.
	3rd - Acetylene bottles (2) Paints; lacquers; waxes
	4th - Naptha, Toluol, Alcohol - Small quantities being used. Unknown solvent in bath
	5th - CO_2 bottle
212	Large commercial quantities of caustics.
215	Soaps, cleaners, adhesives, lubricants.
216	Drawing compounds, resins, bakelite
217	Cyanide (1 drum)
	2 large vats with caustic 1 large vat Phosphoric Acid 1 large vat unknown solvent 3 empty carboys, unknown acid

Building	
217	Shed - 21 carboys H_2SO_4; 4 cans Deoxylyte Complete listing available from Elwood Tees, ext. 5430.
239A	Storage Shed - 55-gallon can caustic soda.
513 518 520	Hydrogen (6), Nitrogen (23), Argon (2) cylinders.
251	Plastic Lab - Large commercial quantities Resins, Polymers, Teflon, polycarbafils, lucites, nylon, cyclo-pellets. Refrigerated quantities of catalysts, teflons, RTV, potting compounds. All being used or to be shipped to ARRADCOM, Dover, NJ. Man in charge of shop at ARRADCOM making arrangements.
59	Commercial quantities of alcohol, ethylene glycol, aviation gasoline.
65	All small quantities are being used.
127	All remaining quantities being used or to be taken to new installations.
144	Examined and cleaned.
235	" " "
48	" " "
55	" " "
240	" " "
239	" " "
148A	Locked.
68	Did not enter (Dr. Mikula)
149	55-gallon drums - molasses, activators, hypochlorites, bentonite, binders, ferrosilicon, silica. Small quantities being used. Radioactive area 6 Argon cylinders; 6 O_2 cylinders; 4 CO_2 cylinders; 2 Acetylene.
150	Commercial quantities Developer - to ARRADCOM Drums - Trichloroethylene; chlorothane; unmarked drums (approx. 15); Unidentified (18) in locked cage. 1 locked cabinet; 1 room radioactive materials. Basement locked.
150	Shed - 1 Argon cylinder.

Building	
308	Solvents in baths
Outside Storage	Pressure bottles; Difluoromethane, Mona Anhydrous ammonia; acetylene; hydrogen.
242	Drums of hydraulic oil; Transitainers; 1 gal. gasoline; 1 five-gallon Freon; 2 cans grinding fluid (50 gal.)

DATE
FILME

2-8